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ORIGINAL ARTICLES

ORTHODONTIC TREATMENT DURING PHYSIOLOGIC RATHER THAN PATHOLOGIC STAGE*

BY THOMAS M. ROBERTSON, B.S., D.D.S., COFFEYVILLE, KANSAS

LAST year the president of our society appointed an Educational Committee to be a permanent standing committee. Its mission in life was to devise means and methods whereby orthodontics, in an ethical manner, might be introduced to the public at a time when patients were still young enough to receive the full benefit of treatment.

In conjunction with Dr. Dewey's public radio lecture recently given, the Southwestern Society of Orthodontists has been able to give more publicity to the fundamentals of our science than it has received in many years.

In all cases of young patients presenting themselves for orthodontic treatment, we are dealing with the subnormal child. Any child whose masticatory apparatus is not capable of performing its full functional activity, is in a degree, a cripple.

Dr. Cryer in speaking of the causes of variation in shape, states that "at the beginning of the growth of the embryo, and continuing through our life, there are two forces constantly acting upon the body," which he describes as "the intrinsic; those giving size and bulk to the tissues, but controlled and modified by the extrinsic, those forces which act from without, tending to limit the growth and give form to the tissues."

"If these two forces be normal—that is properly balanced—in potential strength and application throughout life, the result will be a normally developed organism; but if these forces be interfered with in any way, by lack of nourishment or undue external pressure, the individual may fail to develop a normal physique."

*Read before the Southwestern Society of Orthodontists, Tulsa, Oklahoma, April 8 to 11, 1925.

The earlier these conditions are discovered and the proper preventive or remedial agents applied, the less the general health of the child is involved. The failure to recognize the importane of maintaining the full functional ability of the deciduous teeth, accounts for so many of our patients presenting themselves late in life, with not only a set of teeth out of their normal alignment, but also with a train of disturbances of improper function of the lips, muscles of expression, mastication, abnormal growth of jaws, lips or tongue, and a general lack of harmony and balance of face.

Fig. 1, shows the American beaver cutting its winter supply of white ash. The green bark which it puts in storage furnishes its supply of vitamines during the winter. The fact that the wild animal, with its opportunity

Fig. 1.—American beaver at work. (From National Geographical Magazine.)

to select its own food, does not develop decay or need the service of the orthodontist, should bring to our minds more and more the importance of the mineral constituents of the natural foodstuffs in contrast to the overprocessed and overrefined products which are offered for sale.

In Fig. 2, the effects of normal occlusion and respiratory functions during the life of the individual is shown in the skull (Gray). We do not picture in our mind the owner of this skull during life to be a dyspeptic, an anemic or an irritable person. We have no suspicion of enlarged tonsils; all the teeth are present and in their normal relations to one another.

Contrast the symmetrically developed normal skull (Fig. 2), which has grown under the proper environments, a harmonious, well-balanced face and head, with the skull in Fig. 3. This asymmetrical skull, shows the right side more

fully developed than the left. A number of teeth were evidently lost in early life. Note the absence of normal occlusion. The septum is deflected toward the left side. All internal structures have been disarranged. There is quite a prominent spur, which in life, evidently interfered with the normal function of the turbinate in warming and moistening the air.

Fig. 4, (Cryer) shows a posterior view of a vertical transverse section

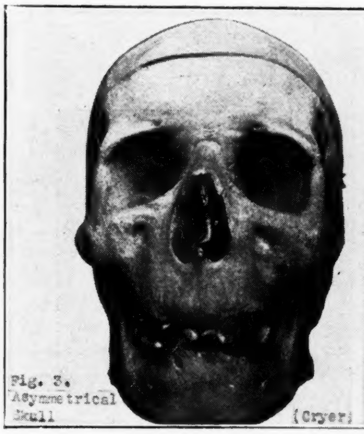

Fig. 3. (From Cryer.)

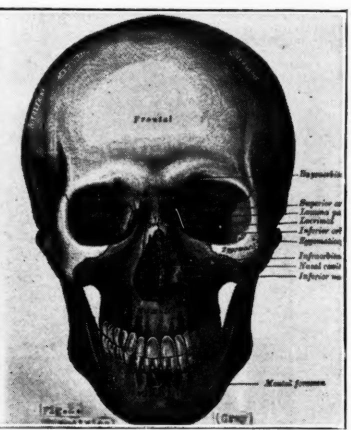

Fig. 2. (From Gray.)

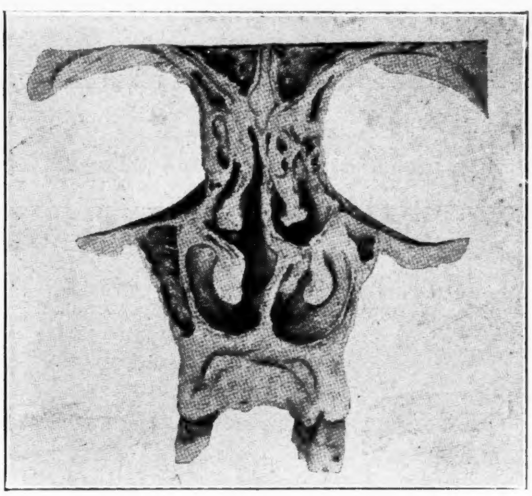

Fig. 4. (From Cryer.)

of the same skull as Fig. 3. It has been cut through in the region of the second premolar, and shows lack of symmetry in the nasal cavity and maxillary sinuses; the inferior meatus is closed anteriorly by the deflected nasal septum which also has a spur.

In Fig. 5, we have the neglected narrow *V*-shaped arch, with the consequent crowding of the nerves and blood supply of the sinuses, the narrowing up of the floor and anterior part of the brain. There is naturally a crowding of the pituitary regions.

The anterior lobe of the pituitary body has been shown by experiments

on animals to exert an influence in the calcic metabolism of the body. The crowding of these pituitary glands results in dwarfing the body by causing lack of skeleton growth. Delayed dentition is also present.

In such cases as depicted in Fig. 5, the normal drainage and oxygenation of the nasal passages and the frontal, maxillary, and ethmoidal sinuses are interfered with.

It is not alone the *ease* with which we correct the *earlier cases,* but to *prevent the permanent abnormal nasal formations* which develop from the

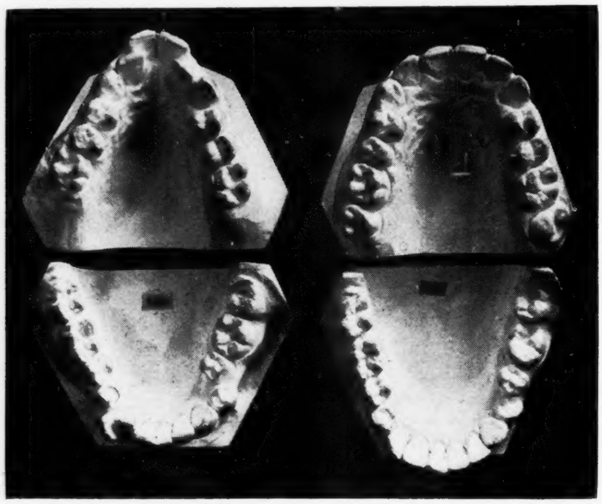

Fig. 5.

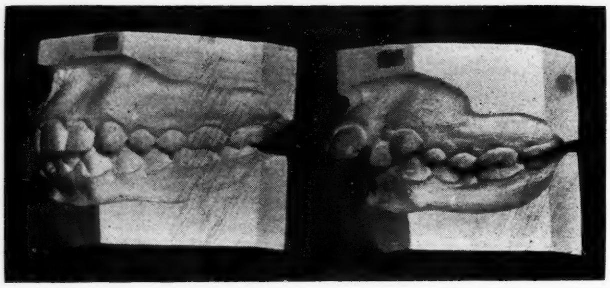

Fig. 6.

continued inflammation produced by the irritation, that these cases should be treated early.

A great deal of the criticism of orthodontic treatment is the high cost of service. This criticism will stand until such time as the general public is educated to the fact that when these cases are brought to us in their last stages of malformations, the lack of functional activities has become so well established, that it takes months and sometimes years to reestablish normal conditions.

In Fig. 6, Model 259, the case was taken at the age of fourteen and

required eighteen months for correction, while in Fig. 6-*A*, Model 286, the case was taken at an earlier age, and gave us the results shown in the working model of 286 in four months' time.

Figs. 7 and 8, which have been reproduced from a recent article by Dr. Lischer, illustrate well the normal and abnormal conditions of the mouth as found in the normal breather, and the mouth-breather.

Fig. 8. shows the well-balanced face, with the muscles of tongue, lips and throat at rest. The forces are balanced from without and from within.

Fig. 7 shows the contracted tongue muscles, contracted arch and protruding teeth. We can readily see how the *least* amount of mouth-breathing breaks up the balancing of the forces of the muscles in relation with the closing of the lips and the contact of the soft palate. The type shown in Fig. 7 would not make a good caddy as he could not give his full attention to the ball because breathing with him is not an automatic process; it is necessary for him to think, to contract his tongue muscles, to produce an air passage over the tongue instead of normally over the palate.

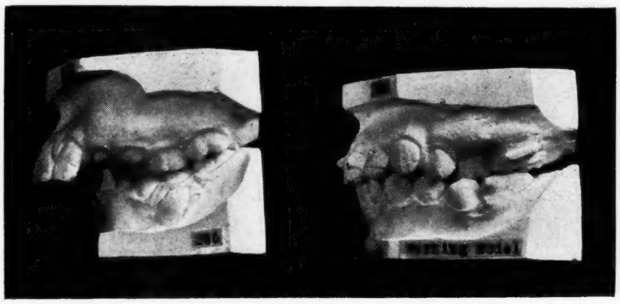

Fig. 6-*A*.

The following quotations are worthy of attention in connection with normal breathing, growth and occlusion.

"We must be sure that we have a normal nasal tract as well as a normal occlusion. Retention will be a failure unless the child is receiving its supply of oxygen in the proper manner." (Dewey.)

"In all the process of development the growth is the result of all the forces to which the bones are subjected, perfectly distributed through the substance of the bone by the agency of normal occlusion." (Noyes.)

"Normal occlusion requires the full compliment of teeth and that each tooth shall be made to occupy its normal position." (Angle.)

Fig. 9 shows a pathologic condition produced by the extraction of superior right and left canines soon after eruption. The cast was made at the age of twenty-four. Note the typical pyorrhea conditions which have developed with the faultily inclined plane occlusion.

In our practice we have limited our orthodontia too much to the correction of malocclusion, when the full meaning of the definition includes prevention.

PUBLICITY CAMPAIGN FOR PREVENTION

We owe a service to the public, to whom the signboard of NORMAL OCCLUSION, pointing to better health, means nothing. If the orthodontic societies in an ethical way, by means of an educational committee, could impress upon the general dental practitioner, the school nurse, the family physician, and the parents of children, the importance of proper nutrition

Fig. 7. (Lischer.)

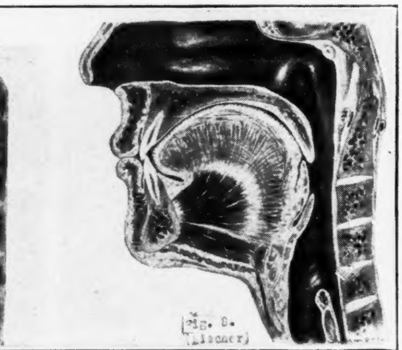

Fig. 8. (Lischer.)

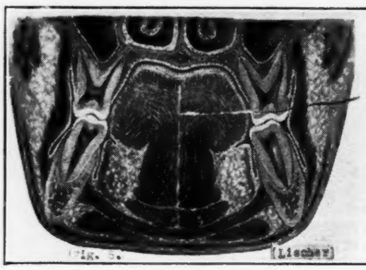

Fig. 8. (Lischer.)

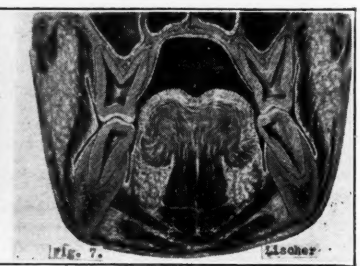

Fig. 7. (Lischer.)

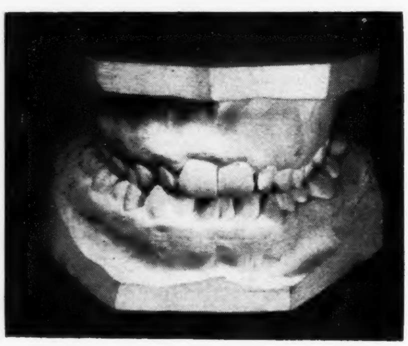

Fig. 9.

and normal breathing, they would have delivered their message of service to the public.

Fig. 10. The narrow arch and faulty incline plane (as shown in 393) at the age of seven years, easily develops into the extreme Class II case (as shown in 197) when neglected.

Patients should be examined with the mouth closed as well as open in order to detect bad lip habits, which if persisted in, lead to malocclusion of

the jaws and impaired health. The necessity for free and unrestricted nasal breathing should be impressed upon patients.

An orthodontist should make a mental invoice of his block and immediate neighborhood. How many of his immediate acquaintances are enjoying good health? How many are robust? The number will be found to be comparatively small. On closer investigation he will find faulty nutrition and improper sanitation of the home and school behind nearly all disease.

If a faulty heavy proteid meat diet in the London Zoo will produce young with cleft-palate, and when the diet is corrected the animals reproduce normal offspring, we can readily see the effect of the use of improper foodstuffs in the patients' general health. Dr. Percy Howe made some very interesting experiments in the feeding of scorbutic diets to guinea pigs resulting in various deformities in the new offspring.

In the experiments carried on in the University of California on the sensitization to certain foods there were found 427 cases of asthma directly traceable to diet.

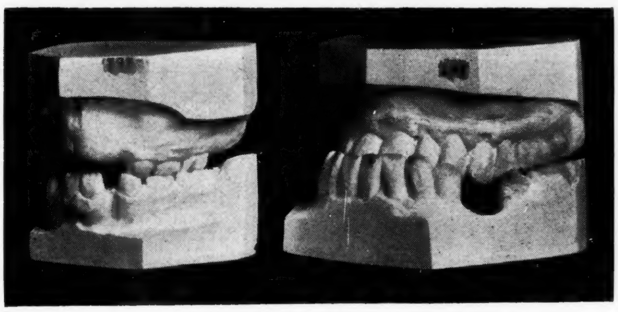

Fig. 10.

It is reasonable to think that many of our chronic congested mucosa are aggravated if not produced by the overingestion of improper foodstuffs.

The following is a list of books that patients should find at the public library. (After they are called for a few times the librarian usually has them.)

"Chemistry of Food and Nutrition," by Dr. Sherman.

"Food Products," by Dr. Sherman.

"Vitamins." Published by Chemical Catalog Company.

"Feeding the Family," by Mrs. Rose.

"Laboratory Handbook for Dietetics." Published by Macmillan.

"Vitamins Manual," by Eddy. Published by Williams and Wilkins, Baltimore, Md.

"Physiology, Hygiene and Nutrition," by Dr. H. W. Wiley. Published by Rand and McNally.

"Newer Knowledge of Nutrition," by McCollum.

"The Science of Eating," by McCann.

"Health," by Dr. Henry Hoffman, Denver. Published by Smith Book Press, Denver.

"Development of the Teeth," by Dr. W. J. Brady.

A NEW AND EFFICIENT MODEL TRIMMER

By R. E. Irish, D.D.S., Pittsburgh, Pennsylvania

EVERY potential thought developed to a reality is done so only through the acceptance of a working hypothesis, and the proving of it to a point of completion. We know that any thought has its beginning or point of inception, and must constantly be entertained during favorable and adverse stages. Fortunately, during both stages I received encouragement and cooperation on the part of my intimate friends and companions, John F. Golden and Edward Harmes, who were always ready to meditate and suggest, so I take this opportunity of acknowledging their interest.

After considerable time spent in the development of a machine that would meet the requirements of our problem, and prove highly efficient, I am presenting my machine which has solved the problem of model trimming in my office.

The machine consists of a motor driven plane, driven either by direct or alternating current motors of one-eighth or one-twelfth horse power of Westinghouse make. I am using a one-eighth horse power (1725 R.P.M.) Westinghouse motor for operation of the machine in my office to insure against or eliminate any possible breakdown as the result of an overload.

The motor is coupled to an encased worm gear, having the proper ratio to the 1725 R.P.M. motor which gives a reduction in speed of seventy-six cuts per minute. Direction of travel of the block is horizontal, Fig. 3, the distance traveled from the moment of action to the moment of rest being three and one-half inches. In its cutting stroke, the block travels slower than in its return stroke, having in this two advantages:

1. It prevents chipping of the models as it travels forward in its cutting stroke.

2. It saves time and prevents dragging of models away from the scale as it returns.

In selecting material for the block, many materials were tried, and aluminum selected because of its lightness and the fact that it will not rust.

The block is five and one-fourth inches wide and five and three-eighths inches long. It is so constructed that replacement of the blade requires but a few seconds, the block being halved and held together by four machine screws, the removal of which makes possible the separating of the halves for the changing of the blade. (Fig. 2.)

In selecting a steel for the blade, the highest grade tool steel was used, thus assuring an edge in sharpening that will withstand the action of plaster against its surface and retain its edge. By using a high grade steel, the problem of rust is eliminated, and with some attention from time to time (removing of plaster and occasional oiling), the blade will not corrode.

As to size, the blade is of sufficient width to cut a large or small amount of plaster at a time, being two and three-fourth inches wide. The blade is five and three-eighths inches in length, sufficient to assure constant use after sharpening until approximately four inches have been ground away. In cutting, the blade may be turned forward three and one-half inches if necessary. Realizing the speed at which the block travels, it is not necessary to turn the blade forward in excess of two or three-sixteenths of an inch.

Replacement of the blade in no way involves the setting of a lock or fixing, in any complicated holder. Simply remove two small machine screws after separation of the halves (Fig. 2) replace with a new blade, reset the two machine screws, approximate the halves (Fig. 3), replace four remaining screws, and the blade is ready for adjustment and operation.

Having in a general way described the essential parts of the machine

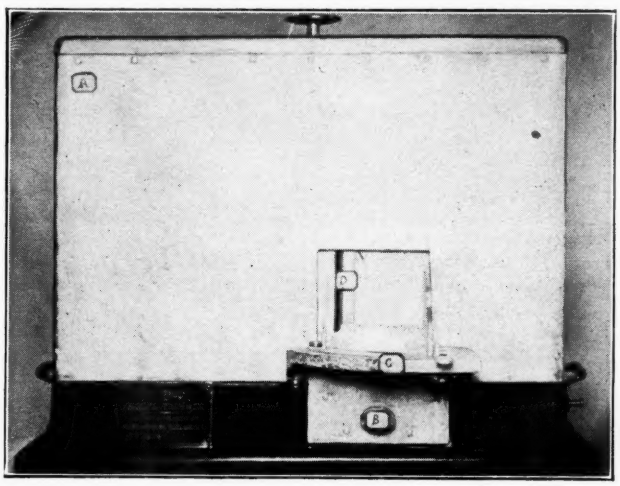

Fig. 1.—*A*, combined cast, and sheet aluminum top; *B*, drawer for holding waste plaster; *C*, combined table and scale for holding model while trimming; *D*, shows block with blade in position for cutting.

and its working principle, the remaining considerations are those of its parts and size.

In construction, the thought of size was essential; also that of symmetry. The machine is constructed entirely of metal on a scale of drawings making it sixteen inches long, eight inches wide, and twelve and one-half inches high. An aluminum top, as shown in Fig. 1, covers the working parts of the machine.

In front of the opening (Fig. 1) is a removable table and scale on which the models are placed for trimming. The scale as best shown in Fig. 3 is adjusted to the desired angle and locked with two wing bolts. On the table are inscribed lines at distances of one-fourth inch at right angles to the blade, thus assuring an accurate cutting of the heel of the model.

Fig. 3 also shows the drawer for catching plaster shavings, located immediately below the table. In Fig. 3, the letter *I* shows a removable brass slide covering the opening through the block. This slide has two advantages,

that of preventing plaster from being thrown over the working parts of the machine, and that of making possible the removal of any plaster jamming as result of being too moist.

Figs. 1, 2, and 3 are lettered and show the mechanical parts of the machine.

As to trimming of the models, measuring and inscribing are done according to Dr. Dewey's technic before cutting. From this point my assistant

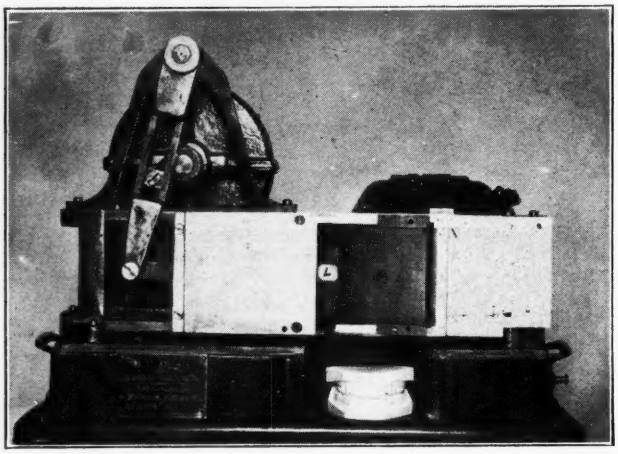

Fig. 2.—*L*, block separated showing the position of blade, also position of halves for placing new blade. Machine trimmed model shown in drawer compartment.

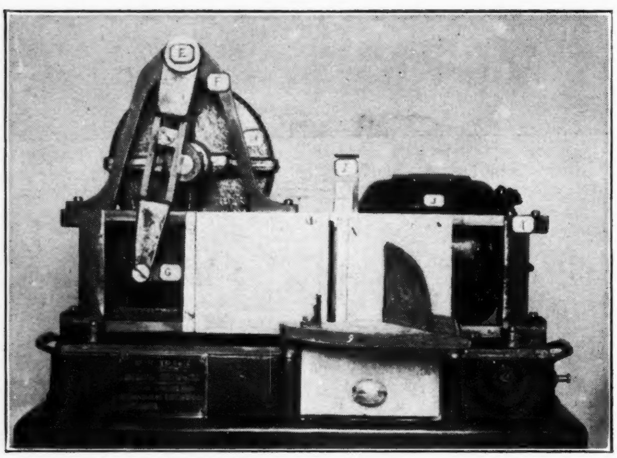

Fig. 3.—*E*, rocker arm; *F*, rocker arm bracket; *G*, driving arm; *H*, gear casing contains worm gears immersed in oil; *I*, brass slide opens into blade making possible removal of plaster not falling into drawer; *J*, ⅛ H. P. Westinghouse motor; *K*, standard for holding rods on which block travels.

trims the heel by paralleling the scale with a line (mentioned in preceding paragraph) on the model table, thus having the scale and model at right angles to the block (Fig. 1), and assuring an accurate cut. The heel is cut to a line inscribed at a point distal to the molars from buccal to buccal, after which the model is placed upright on its heel with the incisal and occlusal surfaces towards the operator, and the base cut in thickness to an inscribed line.

After cutting the heel and base, the angles are cut, this being accomplished by setting the scale to an inscribed or an imaginary line lateral to and paralleling the horizontal or occlusal plane of the teeth in the bicuspid and molar region.

The angles in the anterior portion of the model are cut to an inscribed line, lateral to the labial surfaces of the teeth, or an imaginary line paralleling the horizontal plane of the teeth from the median line to a point distal to, or in the region of the cuspid, the scale being set and locked as stated.

A point I have not mentioned and which is, no doubt, in question, is the feeding of the model to the cutting surface, done simply by a light pressure of the hand.

There was some question as to the accuracy of the scale, but I am fully convinced, as a result of the appearance of the trimmed model, that there is no great need for correction of the same, as the models can be trimmed in a very few minutes.

As mentioned in a preceding paragraph, the machine has proved efficient and has saved time in my office, thus increasing office efficiency.

NEW CEPHALOMETRIC METHOD AND APPARATUS AND ITS APPLICATION TO ORTHODONTIA*

By Dr. Rudolph Schwarz, Basel

Part II

MY OWN RESULTS

At present my discoveries can lay little claim to being complete as research work along this line has not amounted to much. As the art of measuring is progressing daily the results thus become more accurate, and it is a known fact in anthropology that in a graphic map a curve is so much more regular and the figures of the acquired measurements are larger. A little series of research work always develops into a useful result, by displaying a very fine proceeding of measuring. I am exclusively concerned with deformed jaws and must first compare my figures with those of G. Franke[3] (Part I). This author has taken measurements of tooth and jaw anomalies in 1,200 normal skulls and of 150 plaster casts. For measuring widths, he uses the superior maxilla: (1) The anterior width, that is the rectilinear distance from the center of the alveolar margin back of the second deciduous molar, in the deciduous set or anterior to the first permanent molar in the succeeding and permanent set on one side, from a corresponding point on the other side; (2) the posterior width, that is the direct width measurement back of the first molar, and (3) the central width which lies between these two. Another measurement proposed by him is: (4)

*Translated by Dr. Margaret Gortikov from separate copy of the Swiss German monthly *Journal of Dental Surgery*, 1923, xxxiii, Ed. 9.

The height of the arch that is the rectilinear distance from the center of the alveolar width.

According to the anthropologic conception, this is a length measurement, not a height measurement. For orthodontia these measurements are very important because we are dealing mostly with teeth while they are changing and before the second permanent molars are present, and because the eruption of the first permanent molars, according to Angle, are figured as a constant factor. Franke concludes that the development of the maxillary alveolar arch, in reference to the foregoing middle width, diminishes less in the deformed jaw than in the normal jaw. From the first to the last age period, the width of the normal alveolar arch grows about 7 mm. while the deformed one grows but 5 mm. In the first age period, the difference is very slight, amounting to scarcely 0.4 mm., whereas in the last age period, where development is greatest, it is about 2.4 mm. Therefore, we must conclude that the forces of development in deformed jaws decreases more rapidly as age advances. I have measured 136 maxillary casts of orthodontic cases in the same way that Franke did, and obtained the following results: From the first to the last age period, that is from six to thirty-three years, the growth in width of the alveolar arch (centerwise) amounted to only 2.2 mm., whereas the increase for the same length of time according to Franke, is 5.3 mm. In the first age period, from six to seven years, an impression of the central width cannot be taken in younger individuals, as the first permanent molar has not erupted. My average figures are greater than Franke's for the same length of time, with normal jaws. Franke's normal figures must be somewhat too small, as they are taken from children's skulls.

In the second age period, eight to thirteen years, the development amounts to but 1 mm., while in the third, fourteen to twenty-one years, it is about 2.4 mm. which is the same as in the fourth period, twenty-two to thirty-three years. The figures of the last age period correspond accurately with those of Franke's for deformed jaws. The checked growth and premature decrease in the force of development is more distinctly shown in Table I.

TABLE I

ACTUAL WIDTH OF NORMAL AND DEFORMED JAWS

AGES	6-7 YRS.	8-13 YRS.	14-21 YRS.	22-30 YRS.	INCREASE IN MM.
No. of cases (Schwarz) in normal jaws	9	80	38	9	
(Franke)	41.6	44.1	45.9	46.9	15.3
In deformed jaws (Schwarz)	42.3	43.1	43.5	44.5	12.2
Difference	+0.7	–1.0	–2.4	–2.4	

The results are valuable only for the development of the width in the region of the first permanent molar, as the growth does not continue the same for the alveolar and dental arch. First of all, it is interesting to know how the intermaxillary width changes. Therefore, I have measured the intermaxillary width in 149 maxillary cases of orthodontic cases. The point of the compass is placed in the center of the gum papillae, between the centrals and canines on either side. The average intermaxillary width presents the following figures:

TABLE II

AGE	INTERMAXILLARY WIDTH	NUMBER OF CASES
4- 7	22.7	10
8-13	27.9	81
14-21	27.9	49
22-33	29.2	9
Increase	+6.5	149

This shows that the increase between the ages of four to thirty-two years, is 6.5 mm. The greatest development takes place between six and nine years of age in which period the deciduous incisors are replaced by the permanent ones. From thirteen to twenty-one years, the width development is inhibited and from twenty-one to thirty-two years, it is somewhat restored. The growth in the intermaxillary width is more intense in the region of the first permanent molar. Children's skulls portray a direct revolutionary upbuilding of the intermaxilla during the erupting period of the permanent incisors.

The minimum intermaxillary width out of 149 measured skulls amounts to 20 mm. and the maximum to 33 mm. (5 times).

I am in possession of two casts of deciduous teeth and the corresponding casts of the permanent teeth were taken from the same individual in whom no orthodontic measurements were taken. Both cases were absolutely free from caries. The first case is perfectly normal, the first impression having been taken when the child was three and one-half years of age, and the second at ten years. The intermaxillary width in the first model (three and one-half years), amounts to 24 mm., the deciduous molar width, that is, the distance from the center of the cervical margin of the buccal surface of the second deciduous molar on the left side to that on the right side, equals 46 mm. The intermaxillary width in the second cast (ten years) amounts to 31 mm., and the deciduous molar width to 49 mm. The intermaxillary width in the normal maxilla grew 7 mm. between the ages of three and one-half years to ten years, while the jaw in the region of the second deciduous molar grew about 3 mm. during the same length of time. On the second model, the permanent incisors have replaced the deciduous ones; the deciduous molars are still present while the first permanent molar has completely erupted.

In the second case, we are dealing with a boy whose deciduous teeth are malposed. We have distoclusion on the left side, the incisors occlude partially, the canine is completely in linguoversion, the deciduous molar and first permanent molar on the left side are in torsiversion. The intermaxillary width of the first casts (six and three-fourths years) amounts to 22 mm., the width of the deciduous molar region (second molar) is 45 mm. The deciduous set is entirely intact. The first left permanent molar has completely erupted and the right is partially erupted beneath the second deciduous molar.

On the second cast (nine and one fourth years), the intermaxillary width is 28.5 mm. The deciduous incisors have been replaced by the permanent ones. The deciduous molar region width (second molar) cannot be accurately estimated, as only the left deciduous molars are present, the two right ones having fallen out. The first premolar has replaced the first deciduous molar whereas the first permanent molar, which has already partially erupted beneath the

second deciduous molar on the first cast, has completely filled the space for the second premolar as it has moved anteriorly. This fact proves that the space for the eruption of the first permanent molar, also in the intact deciduous set, is not always constant. The rectilinear distance from the center of the buccal cervical margin of the second deciduous left molar to the center of the buccal cervical margin of the right first molar amounts to 45.7 mm. The intermaxillary width of the deformed maxillary arch of the teeth has increased 6.5 mm. between the sixth and ninth years, while the width of the jaw in the region of the second deciduous molar has increased only 0.7 mm. In the cases of both these individuals, the results confirm the foregoing research work: In the deformed jaw, contrary to the normal, the development of the width is retarded, especially in the region of the second deciduous molar.

In order to obtain the relative relationship between the intermaxillary width and that of the molar region, I have formed an intermaxillary index after examining 145 maxillary models with first permanent molars present, which index is similar to Sarasin's, according to the formula.

$$\frac{\text{Intermaxillary width} \times 100}{\text{Molar width}}$$

The width of the molar region is the distance from the center of the buccal surface of both maxillary first molars. The intermaxillary index on an average is:

TABLE III

AGE	INTERMAXILLARY WIDTH	MOLAR REGION WIDTH	INTERMAXILLARY INDEX	NO. OF CASES
4- 7	23.4	51.8	45.17	6
8-13	27.9	57.9	49.40	81
14-21	27.9	55.0	50.72	49
22-32	29.2	55.3	50.99	9
Increase	+5.8	+3.5	+5.82	145

The intermaxillary index between the ages of 6 to 32 years increases from 45.17 mm. to 50.99 mm. This signifies that the intermaxillary alveolar and dental arches become comparatively wider than the arch in the region of the first permanent molar. As the index is greater at fourteen years than at fifty, the intermaxillary width at this period amounts to more than half of the molar region width. In this way it is proved that the anterior segment of the dental arch of both deciduous and permanent teeth have various forms. Franke[3] (Part I) has now confirmed the assertion that the alveolar arch, in the maxilla as well as the mandible, becomes gradually wider but at the same time lower (shorter), and consequently flatter. He has presented a diagram of a Zsigmondyian case of the mandible of the same individual between the ages of six and sixteen years, with the first permanent molars partially erupted.

I have likewise presented a diagram of my two cases and in like manner placed one upon the other, with a base line posterior to the deciduous molars and by means of exact surveying with the help of the raphe. The first case, an entirely normal jaw, is especially suited for this means of measuring because the deciduous molars are still present on the second cast and so the first perma-

nent molar cannot possibly move anteriorly. With the angle-bent crayon, I follow along the cervical gum margin; both the diagrams of the maxilla then furnish a design of the necks of the teeth on the horizontal plane. Fig. 1 now shows that in the maxilla the permanent incisors (dark line) have their lingual margin at the same level as the deciduous incisors (dotted line), and their labial margins are somewhat higher so the labiolingual diameter of the permanent incisors is larger than that of the deciduous incisors. The permanent lateral incisors are erupted in torsiversion so their width diameter is likewise greater. A shortening of the alveolar arch, anterior to the first permanent molar, can certainly be brought about after the loss of the deciduous molar, by the first molar moving anteriorly, which is possible as the premolar is smaller than the deciduous molar. A further foreshortening of the dental arch takes place through the physiologic wearing away of the contact points. In the mandible,

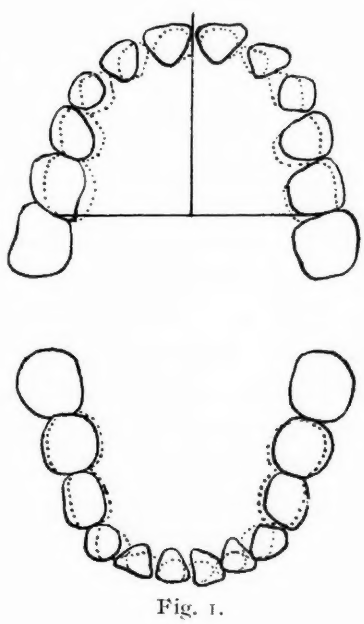
Fig. 1.

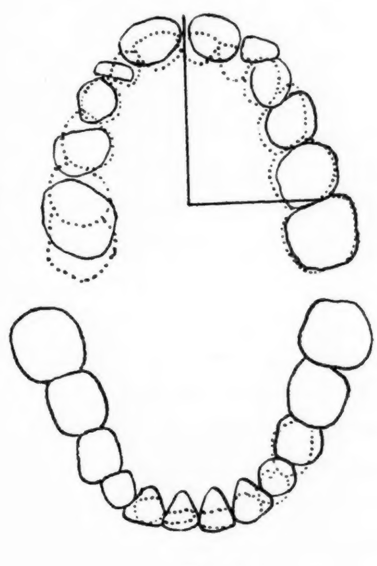
Fig. 2.

the lingual cervical margin of the first permanent incisor is somewhat lingual, therefore the labiolingual diameter of the same is likewise larger; thus the labial cervical margin is at the same level as in the deciduous incisors. From the deformed jaw, we know that the permanent alveolar arch can be higher (longer) as well as lower (shorter) than that of the corresponding deciduous cast and thus we have to deal with either a protrusion or retrusion of the permanent anterior teeth. This is proved in the second case I wrote about (Fig. 2). In the maxilla, the permanent incisors (drawn line) are anterior to the deciduous incisors (dotted line), the occlusion of the left permanent incisor has become normal because of it. In the mandible in Cast I, the deciduous laterals are in position while the permanent centrals are erupting. On the second cast, the left premolar has erupted as well as the permanent lateral incisors, thereby the left deciduous canine is moved somewhat posteriorly. On the first cast, the intervening space for receiving the tooth is represented in Fig. 2, by a dotted

line. The space for the remainder of the teeth is the same on both casts. In the mandible, the permanent incisors have their lingual cervical margins somewhat lingual and their labial at the same level as those of the deciduous incisors; thus they show a similar position to that of the normal case.

We do not content ourselves with the width measurements of the jaws, but can obtain measurements in three dimensions through the help of the new cephalometric method and apparatus, and acquire the corresponding craniometric measurements in cephalometric figures, a thing which has been impossible until now. For a better understanding, further work consists of establishing an anthropologic characterization and drawing. For our purpose the most important head points which are mostly skull points, are the same as selected by Martin[6] (Part I).

Bregma (*b*) in craniometry, is that point in which the sagittal suture is found on the coronal suture. In the living being this point is seldom obtained through palpation. It is approximately in the bipolar frontal plane and therefore it is erected perpendicular to the bitragial point in my diagram. (Fig. 9, Part I).

Opisthocranium (*op*), is the most posterior conspicuous point of the occiput in the median sagittal plane.

Tragus (*t*) is that point of the upper margin of the tragus that in crossing, lies one on the anterior margin and one on the superior margin of these tangent cartilages. This point lies from 1 to 2 mm. below the light spina helicis of the palpebra.

Nasion (*n*), is that point of the nasal root that cuts through the median sagittal plane, the crossing point of the nasofrontal suture and the median sagittal plane. We notice that the nasion as a rule is at the level of the medial end of the hairy eyebrows, mostly on the lower margin.

Subnasal (*sn*) is that point which lies in the intervening angle between the wall of the nasal orifice and the integumental upper lip. It corresponds to no definite point of the skull as the mass of soft tissue in this region is very great and varies in different individuals.

Prosthion (*pr*) is that point in the lower margin of the gums of the superior maxilla which is prominent in the median-sagittal plane between the centrals. This point is located in the under margin of the gums and lies about 1 mm. deeper than the prosthion of the skulls which corresponds with the most anterior intervening point.

Gnathion (*gn*) is that point of the under margin of the mandible which projects mostly from beneath in the median-sagittal plane. By this is meant that point of the mandible which can be palpated from underneath and naturally lies further back than the anterior boundary of the chin.

Infradel (*id*) is that point of the alveolar margin of the mandible which juts out in the median-sagittal plane between the centrals.

Orbital (*or*) is the deepest point of the lower margin of the orbit which is felt easily through the skin. The ear-eye plane passes through the orbit and tragus.

Pogonion (*pg*) is the most prominent point of the anterior chin relief that is the prominentia or external mental spine.

Gonion (*go*) is that point of the mandibular angle which mostly projects from beneath, behind and outward. The measuring points lie in the sideward projection of the angle. The last is easy to find because a distance concavity is found anterior to it, which can also be easily touched in the living being.

For orthodontists it is extremely important to recognize the increased development of the face and ear from six years on.

With the following tables I want to experiment, representing these growths in figures:

WIDTH OF THE HEAD DURING DEVELOPMENT

The rectilinear distance from one tragus to the other can be accurately estimated by our method. The average figures out of seventy-six cases amounted to:

TABLE IV

AGE	T-T	VARIATION IN WIDTH	NO. OF CASES
7-10	132.6	126.0-141.0	23
11-13	134.7	126.0-144.5	26
14-19	140.3	124.4-146.5	27
Increase	+7.7		76

The minimum width (*t-t*) amounts to 124.4 mm., the maximum 146.5 mm. The increase in width of the head in the region of the tragus between the ages of seven to nineteen years amounts to 7.7 mm. Schwarz,[7] has proved, by comparing tenement house children with the children of Basel, as we must deal with similar intermingling of races, that the increase in width of the maximum head width, which is greater than the bitragial width, is 10 mm. from the ages seven to nineteen years. The bitragial width can be compared with the width of the zygomatic arch as they are at the same level but more anterior. According to Schwarz' table, the width of the zygomatic arch in tenement house children (boys) increases about 20 mm. between the ages of seven to nineteen years, and it is 118.138 mm. in size. A further measurement of the width of the face is given as the biorbital width or the rectilinear distance from one orbital point to the other.

Average figures in seventy-six cases are:

TABLE V

AGE	OR-OR	VARIATION IN WIDTH	NO. OF CASES
7-10	67.6	61.0-72.0	23
11-13	68.9	59.0-76.6	26
14-19	70.8	62.4-77.5	27
Increase +3.2			76

The measurements can be compared with the pupillary distance which is nearly 10 mm. smaller however. Steiger (figured according to Martin) has proved an increase of 4 mm. in the pupillary distance in the school children of Zurich, ranging between the ages of ten and fifteen years. It appears that in children with deformed jaws the development of the biorbital width is some-

what retarded. The minimum biorbital width is 59 mm. and the maximum 77.5 mm.

WIDTH OF ORIFICE (MEASURED WHEN AT REST)

Until now the development of the orifice has not been estimated in figures. My measurements produce the following table (average figures):

TABLE VI

AGE	ORIFICE	VARIATION IN WIDTH	NO. OF CASES
7-10	42.6	37.5-48.0	17
11-13	43.8	37.0-50.0	20
14-19	46.3	42.0-53.5	17
Increase +3.7			54

The minimum width is 37 mm. and the maximum is 53.5 mm. The increase in width is about 0.5 mm. greater than in the biorbital width. In orthodontia, not only is the width of the orifice important, but I also recommend the study of the height and profile contour of the integumental upper lip as well as the formation of the mucous membrane.

If by arranging the head in the ear-eye plane, the profile contour of the median part of the integumental upper lip approachs an erected perpendicular, it is known as Orthocheele; if on the contrary, it inclines forward it is known as Procheele; while Opisthocheele, which is the backward inclination of the profile line behind the vertical, is seldom relative.

Plate I, Fig. 4, shows how much Orthocheele contributes toward a harmonizing impression of the face. It deals with a case (Angle, Class I) in which the entire profile angle is the lowest, the jaw indices are the highest and in which the orbital line passes through the first premolar. According to Simon, this portrays a bimaxillary protrusion for which this author recommends as treatment, eventual extraction.

It appears to me that just such very prominent jaws contribute substantially to the harmony of these faces.

Plate I, Fig. 3, shows a Procheele, also in an Angle, Class I, with bimaxillary protraction; it is dependent upon especially strong development of the mucous membrane. Although this face becomes ugly through it, I still contend that it does not produce a mutilation of the set of teeth.

The greatest development of width according to the measured distances in children with teeth and jaw anomalies, is found in the bitragial width (7.7 mm.); next comes the intermaxillary width (6.5 mm.); then the orifice (3.7 mm.), followed by the biorbital width (3.2 mm.), and the smallest increase in width (2.2 mm.) takes place in the region of the first molars of the maxilla.

MEASUREMENT OF HEIGHT DURING DEVELOPMENT

The ear height of the head (head height, vertical diameter, auricular height, vertex to tragus of ear) is the designed deviation between the tragus (*t*) and the bregma (*b*). These measurements which are held firmly by the bregma screw, are obtained with the precision contra-angle and transcribed in the diagram in Fig. 9, Part I.

TABLE VII

AGE	EAR HEIGHT	VARIATION IN WIDTH	NO. OF CASES
7-10	118.6	110.5-130.0	20
11-13	120.3	120.0-139.0	22
14-19	121.4	111.0-130.0	22
Increase +2.8			64

These figures correspond fairly accurately with those of Schwarz,[7] conformably for tenement house children. The ear height, which is also a measurement of the cranium of the skull, is not influenced by anomalies of the jaw. The development of the height of the face yields the following measurements as a key:

TABLE VIII

THE VERTICAL DISTANCE OF THE GNATHION FROM THE EAR-EYE PLANE

AGE	E. E. P.-GNATHION	VARIATION IN WIDTH	NO. OF CASES
7-10	81.2	73.0-86.5	13
11-13	83.1	73.0-93.0	14
14-19	88.9	81.0-96.0	20
Increase +7.7			47

The height development of the segments of the face that extend from the ear-eye plane to the gnathion, and which correspond to the height of our model, amounts to 7.7 mm. between seven and nineteen years of age.

I have measured the perpendicular distance of the interdental papillae between the central incisors of the maxilla and the ear-eye plane and at the same time from the interdental papillae between the centrals to the top of the gum margin back of the first molar tooth so as to know how to control not only the height development of the jaws in the incisal region, but also in the molar region. A summary of the average figures yields the following results:

TABLE IX

	PERPENDICULAR DISTANCE OF INTERDENTAL PAPILLAE BETWEEN CENTRAL INCISORS FROM EAR-EYE PLANE		VERTICAL DISTANCE OF GUM MARGINS POSTERIOR TO THE FIRST MOLARS FROM EAR-EYE PLANE.		
AGE	AVERAGE	VARIATION IN WIDTH	AVERAGE	VARIATION IN WIDTH	CASES
7-10	39.2	32.0-42.5	33.1	29.0-37.0	18
11-13	41.3	35.0-49.0	33.5	21.0-45.0	19
14-19	43.9	38.0-51.0	38.7	33.5-46.0	24
Increase	+4.7		+5.6		61

The height development is somewhat greater in the molar region. The perpendicular distance of the nasion from the ear-eye plane, which is held firmly by the help of the nasion screw, yields the following average figures:

TABLE X

AGE	N-E. E. P.	VARIATION IN WIDTH	NO. OF CASES
7-10	24.3	18.0-33.0	18
11-13	24.3	18.0-29.0	19
14-19	25.2	19.0-33.0	24
Increase +0.9			61

The increase in development between the ages of seven and nineteen years amounts to 0.9 mm.

For the height of the upper part of the face (I do not measure the rectilinear, but the perpendicular deviation of the nasion from the interdental papillae between the central incisors), the following are the average figures:

TABLE XI

HEIGHT OF UPPER PART OF THE FACE

AGE	PERPENDICULAR DISTANCE OF NASION (N) FROM THE INTERDENTAL PAPILLAE BETWEEN CENTRALS	VARIATION IN WIDTH	NO. OF CASES
7-10	63.5	47.0-73.0	18
11-13	65.6	58.5-73.0	19
14-19	69.1	62.0-78.0	24
Increase +5.6			61

For the height of the face (morphologic height of the face), I measure the perpendicular distance between the nasion and gnathion, giving the average figures of:

TABLE XII

MORPHOLOGIC HEIGHT OF THE FACE

AGE	PERPENDICULAR DISTANCE OF NASION FROM GNATHION	VARIATION OF WIDTH	NO. OF CASES
7-10	105.5	105.5-112.0	13
11-13	108.1	100.0-118.5	14
14-19	114.1	104.5-121.5	20
Increase +8.6			47

According to the investigation of Schwarz, for tenement house children, during the same age period the rectilinear distance on an average is as follows:

TABLE XIII

MORPHOLOGIC HEIGHT OF FACE IN TENEMENT HOUSE CHILDREN (SCHWARZ)

AGE	AVERAGE
7-10	102.7
11-13	109.3
14-19	116.7
Increase	+14.0

Whereas, in children with normal jaws, the height of the face increases 14.0 mm. between seven and nineteen years. This increase amounts to but 8.6 mm. in children with tooth and jaw anomalies. While the height of the face when the jaws are deformed (Basel), is greater during the first age period, the difference amounts to 1.2 mm. in the second period and minus 2.6 mm. in the third. It shows very distinctly in the development of the height of the face that the force of development in a deformed jaw, diminishes more readily than in the normal jaw as age advances.

THE HEIGHT OF THE PALATE DURING DEVELOPMENT

For the height of the palate, I measure the perpendicular distance to the ear-eye plane of the roof of the palate to the gum margin back of the first molar, (figured out in the diagram in Fig. 9, Part I) or directly on the model by means of the horizontal needle and contra-angle. The following average resulted:

TABLE XIV

AGE	HEIGHT OF PALATE	NO. OF CASES
7-10	9.6	28
11-13	11.9	31
14-19	13.5	31
20-32	15.2	6
Increase	+5.6	96

Franke,[3] (Part I) has determined that the deformed jaw, on an average, produces palates 3 to 4 mm. higher than the normal jaw, that is, it has been retarded 3 to 4 mm. in growth before the eighth year; the deformed palate is 3 mm. ahead of the normal in height. My measurements are well in accord with those of Franke.

Without admitting to myself whether or not mouth-breathing has any connection with the height of the palate, I must show, in connection with the subject, that a high palate, measured back of the first molar surely represents no anomaly. The extent of the roof of the palate can best be studied in the median-sagittal curve. Plates II and III show that in the deformed jaw, the height of the palate crownwise (dotted line), often lies in front of the first molar and can reach to the region of the canine tooth. (Plate II, Figs. IX and X, Plate III, Fig. XIV.) This case depends upon the pathologic proceedings and it confirms Franke's assertion that the high palate, though it sounds like a paradox, is the consequence of faulty development.

LENGTH MEASUREMENT DURING DEVELOPMENT

The maximum length of the head is the rectilinear distance of the nasion (*n*) to the opisthocranium (*op*). Martin obtained the following results without facebow (average figures):

TABLE XV

AGE	N-OP.	VARIATION IN WIDTH	NO. OF CASES
7-10	180.2	172.0-200.0	17
11-13	180.5	167.5-198.0	23
14-19	182.9	172.0-198.0	20
Increase +2.7			60

The minimum head length amounts to 167.5 mm., the maximum to 200 mm. The figures for tenement house children yield the following:

TABLE XVI

AGE	N-OP.	VARIATION IN WIDTH
7-10	173.5	154.0-188.0
11-13	177.0	163.0-192.0
14-19	180.6	155.0-201.0
Increase +7.1		

In the Basel children, who have deformed jaws, the average figures are greater than in the tenement house children, the increase in development being less than 4.4 mm.

As to the length of the head, it is possible without a new method of measuring, to estimate the length of the base of the head and the length of the face by means of the very analogous cephalometric measurements. The length of the

base of the skull of the respective heads (foundation line of the skull, nasobasilar line, ligre nasobasilaris, basinasal length) is the rectilinear distance between the nasion (*n*) and basion (*ba*). Instead of the basion, I use the bitragial point, which is in front of the basion (*ba*) and somewhat higher than it. The following table (average figures) is the result:

TABLE XVII

AGE	N-BT	VARIATION IN WIDTH	NO. OF CASES
7-10	88.5	82.0- 95.6	16
11-13	89.4	82.4- 99.6	21
14-19	91.8	81.9-100.5	21
Increase +3.3			58

The base length of the head grows 3.3 mm. between the ages of seven to nineteen years.

The projected distance on the ear-eye plane is as follows:

TABLE XVIII

AGE	N-BT	VARIATION IN WIDTH	NO. OF CASES
7-10	85.0	80.0-96.4	16
11-13	86.2	80.0-95.0	21
14-19	88.2	82.3-95.0	21
Increase +3.2			51

The length of the face (depth of face, profile length of face, basi-alveolar length), is the rectilinear distance of the basion (*ba*) from the prosthion (*pr*). (Martin, p. 40.) The bitragial point is again placed in the position of the basion (*n-bt*). The average figures are:

TABLE XIX

AGE	PR-BT	VARIATION IN WIDTH	NO. OF CASES
7-10	89.0	84.7- 96.3	16
11-13	89.0	81.2-105.3	21
14-19	93.6	84.0-104.5	21
Increase +4.6			58

The facial length grows between the ages of seven and nineteen years, about 4.6 mm. and the greatest period of development occurs between the fourteenth and nineteenth years. The increased development of the length of the face is about 1.3 mm. greater than in the length of the base of the head.

Independent of the height of the face, the projected distance on the ear-eye plane is:

TABLE XX

AGE	PR-BT	VARIATION IN WIDTH	NO. OF CASES
7-10	80.6	76.7-89.3	16
11-13	80.5	74.0-99.0	21
14-19	85.0	76.0-96.0	21
Increase +4.4			58

In reference to the length of the alveolar arch (alveolar arch height according to Franke) measurements yield the following results:

TABLE XXI

RECTILINEAR DISTANCE FROM THE CENTER OF THE ALVEOLAR MARGIN BETWEEN THE CENTRAL INCISORS AND THE MORE ANTERIOR WIDTH

BETWEEN AGES OF:	5-7	8-13	14-21	22-33	DECREASE MM.
In normal jaws (Franke)	23.8	22.1	22.0	21.3	–2.5
In deformed jaws (Schwarz)	24.5	26.3	25.2	24.1	–0.4
Difference	+0.7	+4.2	+3.2	+2.8	

It confirms Franke's assertion that the height of the alveolar arch of deformed jaws, on an average, is greater than in the normal, which is brought out by the fact that most anomalies occcur in the intermaxillary region. Herbst[1] recently remarked about this fact.

THE POSITION OF THE FIRST MAXILLARY PERMANENT MOLAR

As the position of the maxillary first molar plays such an important part in orthodontia, I have measured the distance from the distal surfaces of the maxillary right first permanent molar, according to the height of the papillae of the gums to the bitragial point on the ear-eye plane, in Fig. 9, Part I, and measured the distance from the cutting point to the bitragial point (*bt*). Thus I obtain the projected measurement on the median plane, or in Fig. 7, Part I, I observe the perpendicular distance from the middle of the distal surface of the maxillary right permanent first molar to the raphe-median plane, and measure the distance from the cutting point to the bitragial point.

The average figures during development are:

TABLE XXII

AGE	PROJECTED DISTANCE AT FIRST MOLAR TO BITRAGIAL POINT	VARIATION IN WIDTH	NO. OF CASES
7-10	41.5	37.3-49.5	15
11-13	43.9	35.5-58.0	18
14-19	46.3	39.0-53.9	20
Increase +4.8			53

That means that the first permanent maxillary molar moves 4.8 mm. further from the bitragial point during the nineteenth year than during the seventh year. When comparing the development of the entire head, it is important to consider the derangement absolutely as well as comparatively. The first permanent molar, however, can be referred to as occcupying a constant position.

RECTILINEAR DISTANCE FROM THE BIORBITAL POINT TO THE BITRAGIAL POINT

The distance in the median sagittal plane can be determined in Figs. 7 and 9, Part I.

TABLE XXIII

AGE	BIORBITAL BITRAGIAL POINT	VARIATION IN WIDTH	NO. OF CASES
7-10	68.2	56.0-76.0	23
11-13	67.3	61.5-77.0	26
14-19	70.9	61.0-80.0	27
Increase +2.7			76

The distance from the biorbital to the bitragial points grows about 2.7 mm. during the ages of five and nineteen years, and it is the measurement that changes least of all during development; it changes even less than the length of

the base of the skull, a fact which speaks very favorably of the orbital plane as a measurement plane.

By the protrusion or retrusion of the maxillary and alveolar portions marked opposite the base of the skull, I can form an index similar to the *Flow-eric Jaw Index, Gnathic Index,* by which the length of the face and base of the head can be compared with each other. I put the bitragial point in the face of the basion, as it lies in the median-sagittal plane and I can accurately measure it in the living being by my method. It is an established fact that in children's skulls, the porion as well as the bitragial point, lies in front of the basion. In the adult, the porion lies in the same frontal plane as the basion, in fact the basion can move anterior to the porion (Neumayer, Martin, p. 605). The bi-tragial point, according to my estimation, lies in front of and above the basion and it is almost 2 cm. higher in the negro skulls (New Hebrides).

The formula for the cephalometric jaw index is:

$$\frac{\text{Length of the face} \times 100 = pr. - bt. \times 100}{\text{Length of the base of the head } n - bt.}$$

The cephalometric index yields higher figures than the craniometric, because the distance from the prosthion to the bitragial point is greater than the distance from the prosthion to the basion. The classification for the craniometric index then does not correspond with the cephalometric index. The higher the index, the more prominent the jaw. The average figures are as follows:

TABLE XXIV

AGE	JAW INDEX	VARIATION IN WIDTH	NO. OF CASES
7-10	100.53	97.03-110.24	16
11-13	99.57	91.81-107.26	21
14-19	101.90	88.25-111.64	21
Increase +1.37			58

These results show that the jaw becomes more prominent as age advances. In this index however, the height of the upper part of the face is not considered; nevertheless, it can be seen according to the same index that the jaw is more prominent in a relatively low face than in a relatively higher one. I can overcome this mistake by the help of my graphic map in which I use the projected distance on the ear-eye plane instead of the rectilinear distance, which measurement can be estimated in Fig. 9, Part I. For the projected measurement, the following figures are given:

TABLE XXV

AGE	JAW INDEX FROM THE PROJECTED MEASUREMENT	VARIATION IN WIDTH	NO. OF CASES
7-10	94.79	87.39-102.28	16
11-13	93.42	84.31-108.28	21
14-19	96.36	89.33-105.55	21
Increase +1.57			58

This shows that during the second age period, the index figure diminishes. Thus we obtain no regulated series; Table XXV always shows that the jaws are more prominent during the third age period than during the first.

By the Floweric jaw index, I can estimate the prominence of the facial portion of the skull over the cranial portion of the *profile angle of the face.*

Through the painstaking work of H. Luthy, it has been shown that the so-called entire profile angle, that is the angle formed by the nasion, prosthion line, with the ear-eye plane, furnishes a valuable conclusion as to the characterization of the human species. Luthy and Martin have produced the following classification of the entire profile angle:

Hypergnathus	–69.9
Prognathus	70–79.9
Mesognathus	80–84.9
Orthognathus	85–92.9
Hyperothognathus	93–

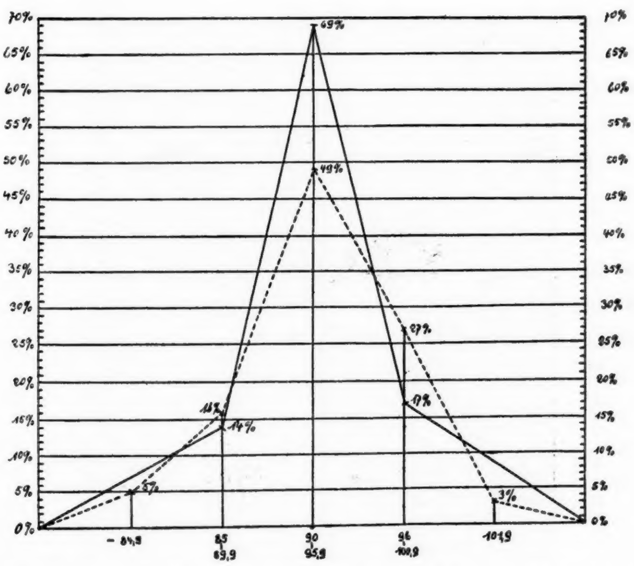

Fig. 3.—Entire profile angle. Black line, entire profile angle in 22 boys; dotted line, entire profile angle in 37 girls.

Sarasin introduced a new grouping which is the following:

Hyperprognathus	–74.9
Prognathus	75–79.9
Mesognathus	80–84.9
Orthognathus	85–89.9
Hyperorthognathus	90–

Pronounced orthognathus constitutes the European grouping. In the living being, this angle has been measured with a compass and attachable goniometer until now, but the results are not positive. By means of my new graphic representation, I can most accurately estimate the profile angle. It is interesting to note to what extent the craniometric profile angle changes when tooth and jaw anomalies are present. According to Luthy, the entire profile angle varies from 82° to 91°, in the Swiss (Bundnern). According to Torok, the maximum profile angle amounts to 101°. Fig. 3 shows the percentage curve of the entire

profile of twenty-two boys and twenty-seven girls who have tooth and jaw anomalies. Both have their coronal portion in hyperorthognathus. The quota is 90° to 95.9°, the boys having 69 per cent, and the girls 49 per cent. In 17 per cent of the boys, the profile angle varies from 96° to 98°; in 30 per cent of the girls, from 96° to 101.5°.

Mesognathus is not found in boys; 5 per cent of the girls have mesognathus whereas orthognathus is found in 14 per cent of the boys, and 16 per cent of the girls. In boys, the minimum angle measurement is 87°, and the maximum 98°. In girls, the cases vary from 84.5° to 101.5°. Prognathus, in the anthropologic sense, never occurs with tooth and jaw anomalies in the Basel children, and mesognathus is very seldom present.

The position of the length of the face anterior or posterior, to the length of the base of the skull can be obtained directly from Figs. 7 and 9, Part I, in

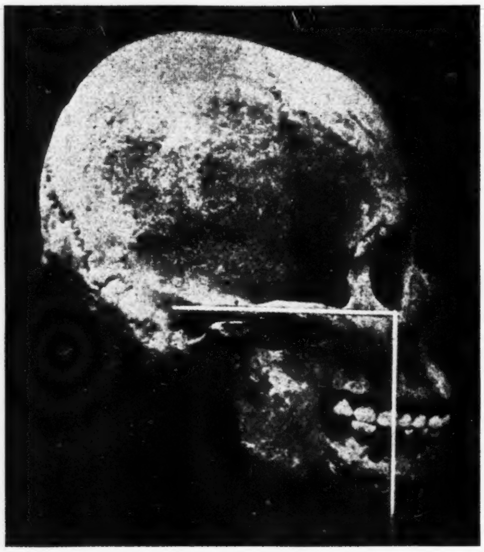

Fig. 4.—New Caledonian skull. (Collection of Dr. F. Sarasin, Basel.)

which the position of the nasion is compared with that of the prosthion. It is said that in anthropology, experiments have been carried out measuring the degree of prognathus by the amount of protrusion of the maxilla, anterior to the vertical plane (so-called linear method). Simon[11] (Part I), has taken this method up for orthodontia and chooses for his new classification of malocclusion the *orbital plane* as the vertical plane, which passes through both orbital points and is perpendicular to the ear-eye plane. He measures the degree of pro- or retrustion of the dentures to the upper part of the face and in what way the orbital plane cuts across these dentures. The study of this plane leads us to an interesting conclusion for the diagnosis of racial as well as tooth abnormalities; Simon has shown that the cutting point of the orbital plane, between the ages of five to forty-five years, passes through the canine tooth in Europeans (law of canine teeth). In the New Caledonians, who among recent races show the greatest prognathus, it passes through the first permanent molar (Fig. 4). In my new method of graphic presentation, I use the orbital plane for survey-

ing and as a measurement plane, but I do not limit myself to this alone, but also consider the jaw index, profile angle and important cephalometric points, so as to be able to accurately figure the relationship between the jaw, teeth and the head. The graphic representation of the extent of the orbital line in *eighty-seven orthodontic cases,* survey the graphic map in a percentage curve (Fig. 5), which according to Herzog's scheme, is sketched for both sides and this with my method, I can determine the true orbital plane which passes through both orbital points. Simon, with his measuring beam, can only mark the point where the orbital line cuts the raphe, the first is merely drawn through perpendicularly to the latter. The right curve corresponds with the crown in the posterior part of the distal half of the canine teeth in 15 per cent of the cases. In 13 per cent, the orbital line passes through the anterior distal half of the canine teeth; in 10 per cent, through the center; in 8.5 per cent, through the posterior mesial

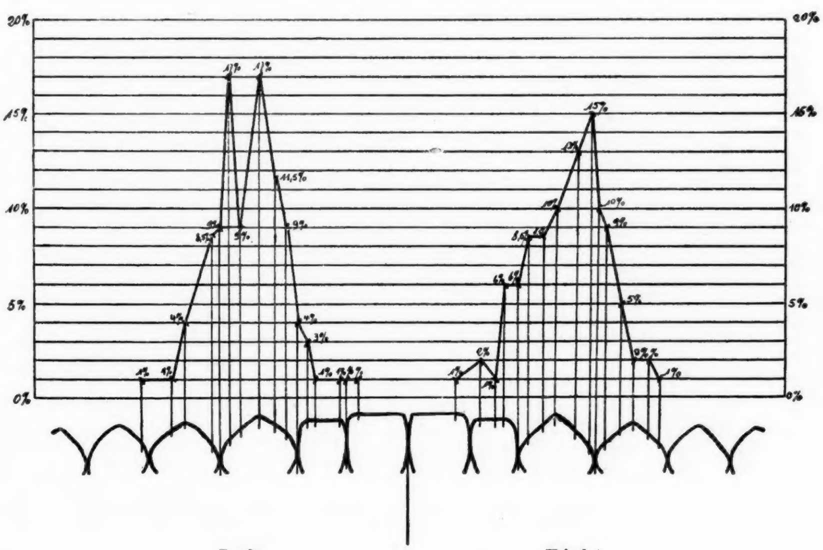

Fig. 5.

half, and 8.5 per cent also, through the anterior mesial half. In 6 per cent of the cases, it is found between the laterals and canines, in 6 per cent in the posterior distal half, in 1 per cent in the center, and in 2 per cent in the anterior mesial half. We find that in 1 per cent of the incisors it is in the incisal edge of the posterior, distal half. In 10 per cent it is found between the canines and first premolars, in 9 per cent it passes through the anterior mesial half of the first premolar, in 5 per cent through the posterior mesial part and in 2 per cent, through the center of the first premolar; through the anterior distal part in 2 per cent, and through the posterior distal part in 1 per cent. The percentage curve of the left side shows two maxima. In 17 per cent of the cases, the orbital line passes through the tip of the canine, in 17 per cent also it is somewhat larger than on the right side which extends from the posterior distal half of the central to the anterior mesial half of the second premolar.

Comparing the results of the jaw index and profile angle on one side with the orbital line on the other, it shows that in the three cases, with the lowest

profile angle and highest jaw index, the orbital line cuts partly through the first premolar and partly through the second premolar. A similar harmony exists in the three cases with the maximum profile angle and the minimum jaw index. In these instances, the orbital line passes partly through the laterals and partly through the anterior mesial half of the canine. The pro- or retrusion of the jaw portion can be determined with certainty not only by the orbital line and shows that the orbital points can be accurately placed with a precision facebow and carried on to the model unaltered.

MEASUREMENT OF THE MANDIBLE DURING DEVELOPMENT

From the mandibular measurement we obtain the width of the angle of the mandible (width of lower part of the face), by our method, the rectilinear distance of both gonia (*go*) that is the individual mandibular angle (Martin, p. 66). The following figures are the average ones:

TABLE XXVI

AGE	GO-GO	VARIATION IN WIDTH	NO. OF CASES
7-10	95.2	82.0-102.5	9
11-13	99.6	85.0-109.0	11
14-19	105.8	93.0-126.5	15
Increase +10.6			35

The width of the mandibular angle increases about 10.6 mm. between the ages of seven and nineteen years. We thus prove an active development of the width of the mandibular angle region. The greatest increase is found between the ages of fourteen and nineteen years. As the height measurement, chin measurement (mandibular height, height of the symphysis), I measure the perpendicular distance between the infradental (*id*) and the gnathion (*gn*). With the help of the chin cap, I have obtained a plaster cast of the chins and the undersurface of the mandibular models correspond with the horizontal gnathion plane. I can take these measurements directly with the help of a horizontal needle and a graduated contra-angle, and with it, I can figure the chin height in Diagram 3. The figures are:

TABLE XXVII

AGE	ID-GN	VARIATION IN WIDTH	NO. OF CASES
7-10	34.2	32.5-37.5	13
11-13	35.0	30.0-40.0	14
14-19	37.2	37.2-40.5	20
Increase +3.0			47

To estimate the length (depth of the mandible), I take two measurements:

1. The distance of the infradental to bitragial point drawn on the ear-eye plane.
2. The distance of the pogonion (*pg*) the most anterior portion of the anterior chin relief, to the bitragial point projected on the ear-eye plane.

Through it, I obtain an accurate picture of the relationship of the mandibular-alveolar movement to the chin. Both measurements can be figured out in the diagram in Fig. 9, Part I, or with the help of a horizontal needle, and graduated contra-angle, I measure directly on the model. The figures are:

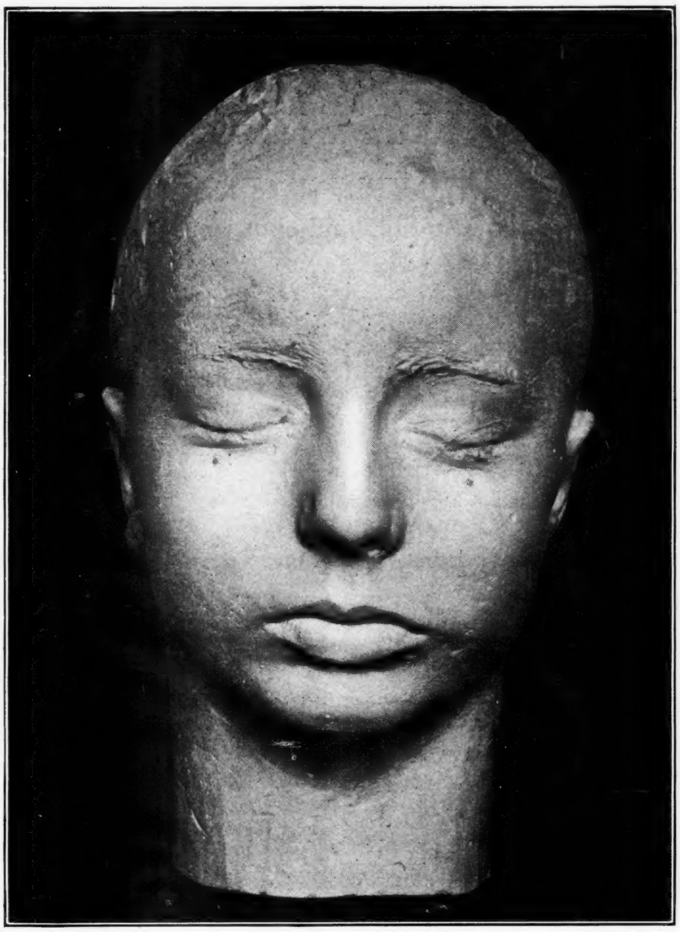

Plate I, Fig. 1.—Asymmetrical suppression of left side of face.

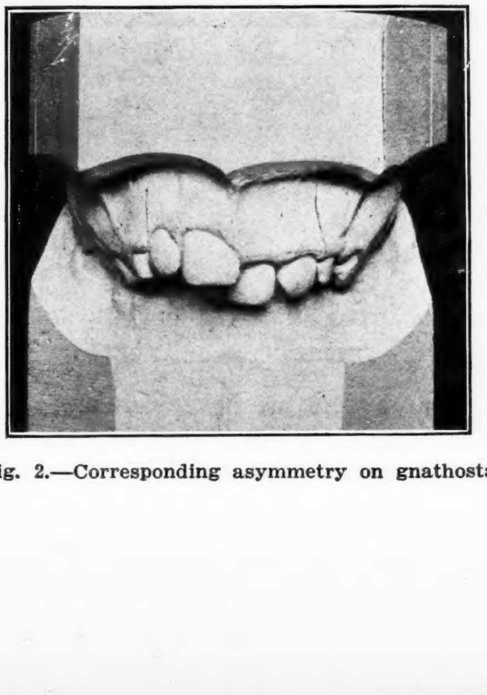

Plate I, Fig. 2.—Corresponding asymmetry on gnathostat model.

TABLE XXVIII

AGE	INFRADENTAL BITRAGIAL POINT	VARIATION IN WIDTH	CASE	AGE	POGONION BITRAGIAL POINT	VARIATION IN WIDTH	CASE
7-10	75.9	73.3-79.8	13	7-10	81.0	78.2-83.8	13
11-13	76.1	73.5-81.2	16	11-13	80.2	79.8-83.0	16
14-19	75.8	73.0-78.6	20	14-19	79.4	78.6-80.4	20
Decrease –0.1			49	Decrease –1.6			49

For both measurements we discern a slight loss. The relationship between the alveolar movement of the mandible and chin can be further noticed through the profile angle of the mandible (chin angle) (Angle Symphesian) Martin 79.[1] The other angle, the infradental and pogonion, that is, the most prominent part of the chin in the median-sagittal plane, forms a straight target with the ear-eye plane. This angle can be measured in Fig. 9, Part I, where the mandible is in accurate occlusion with the maxilla. The angle is measured horizontally. The average figures are:

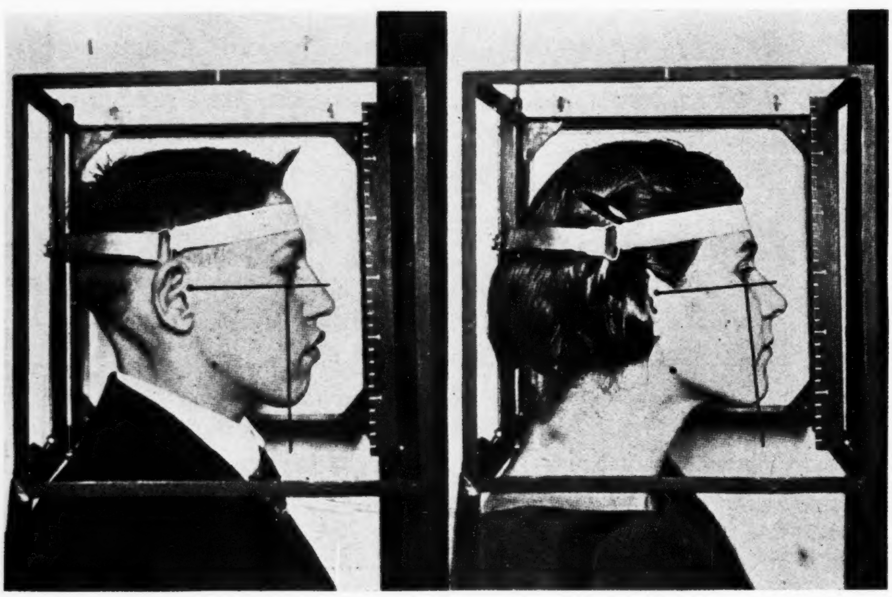

Plate I.
Fig. 3.—Procheile. Fig. 4.—Orthocheile.

TABLE XXIX

AGE	CHIN ANGLE	VARIATION IN WIDTH	NO. OF CASES
7-10	101.1	92.5-112.0	14
11-13	98.3	92.0-107.0	13
14-19	98.6	82.0-109.5	20
Decrease –2.5			47

THE RELATIONSHIP OF THE ALVEOLAR PLANE OF THE SUPERIOR MAXILLA TO THE HORIZONTAL PLANE

In the foregoing research work, we have dealt mostly with the jaws during tooth development, thus the occlusal plane is not suitable as a measurement plane. I select the alveolar plane which is determined anteriorly by the interdental papillae between the centrals and posteriorly by the gum margin back of the first molar, instead of the second. The angle formed by the alveolar plane with the

ear-eye plane yields the results seen in Plates II and III. The drawings are made with my new stereograph. The greatest angle we measured amounted to 21° (Plate III, Fig. XX), the lowest to -3° (Plate III, Fig. XVIII). Out of twenty-four cases that were built up, three show negative angles, that is, the

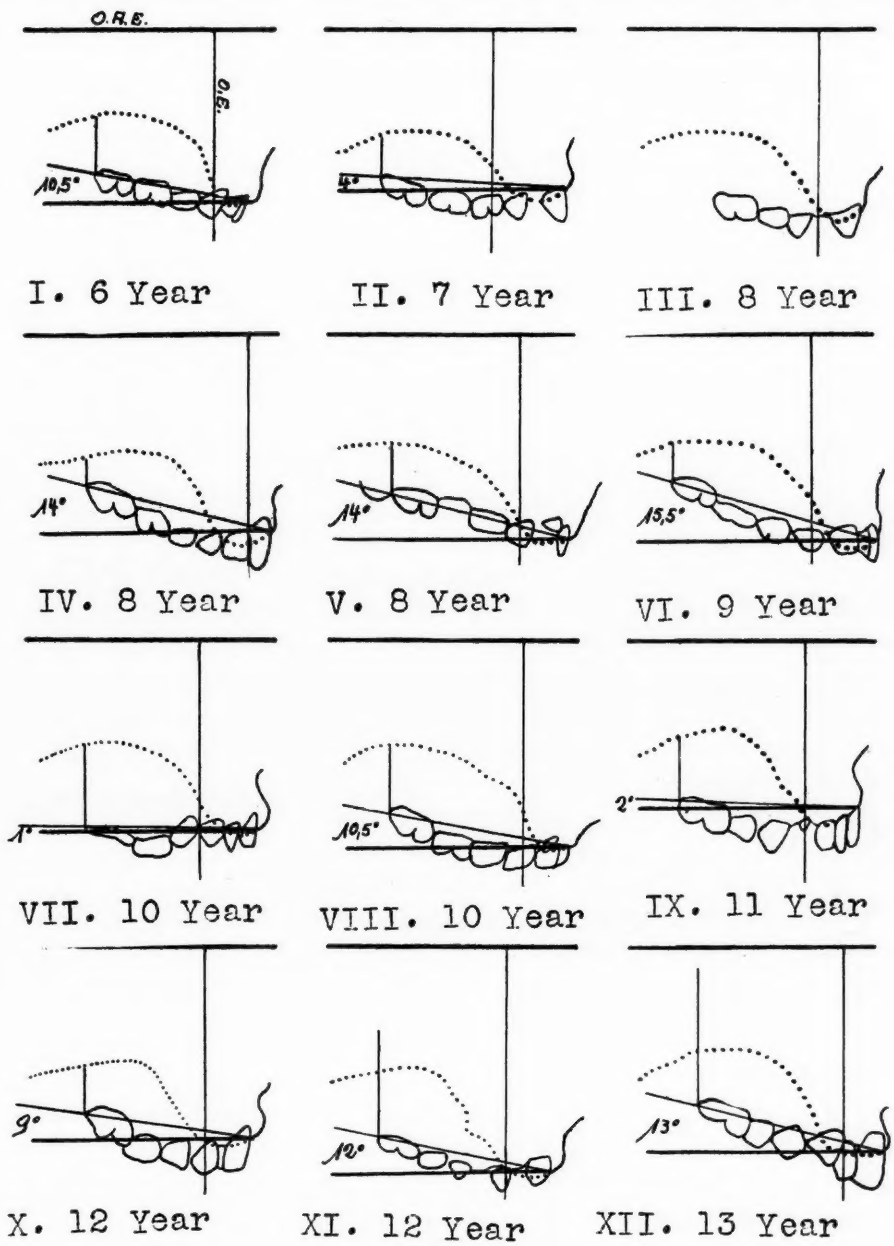

Plate II.

Plates II and III.—Graphic map of the median sagittal palatal curve (dotted line) and the inclination of the alveolar plane to the ear-eye plane.

alveolar plane projects forward opposite the horizontal plane. Hans Virchoud,[8] has extended the alveolar plane to the second molar with the help of a complicated special apparatus. He claims the widths to vary from 1° to 16°. L. and Ch. Ruppe,[3] have studied the relationship of the occlusal plane to the camperic

plane and to the Frankfort horizontal plane, and have determined the different inclinations of the occlusal planes in the normal skull.

PRE- AND POSTAURICULAR PART OF THE HEAD

During development, the relationship of the longitudinal measurements of the pre- and postauricular parts change. The head of the newborn is marked

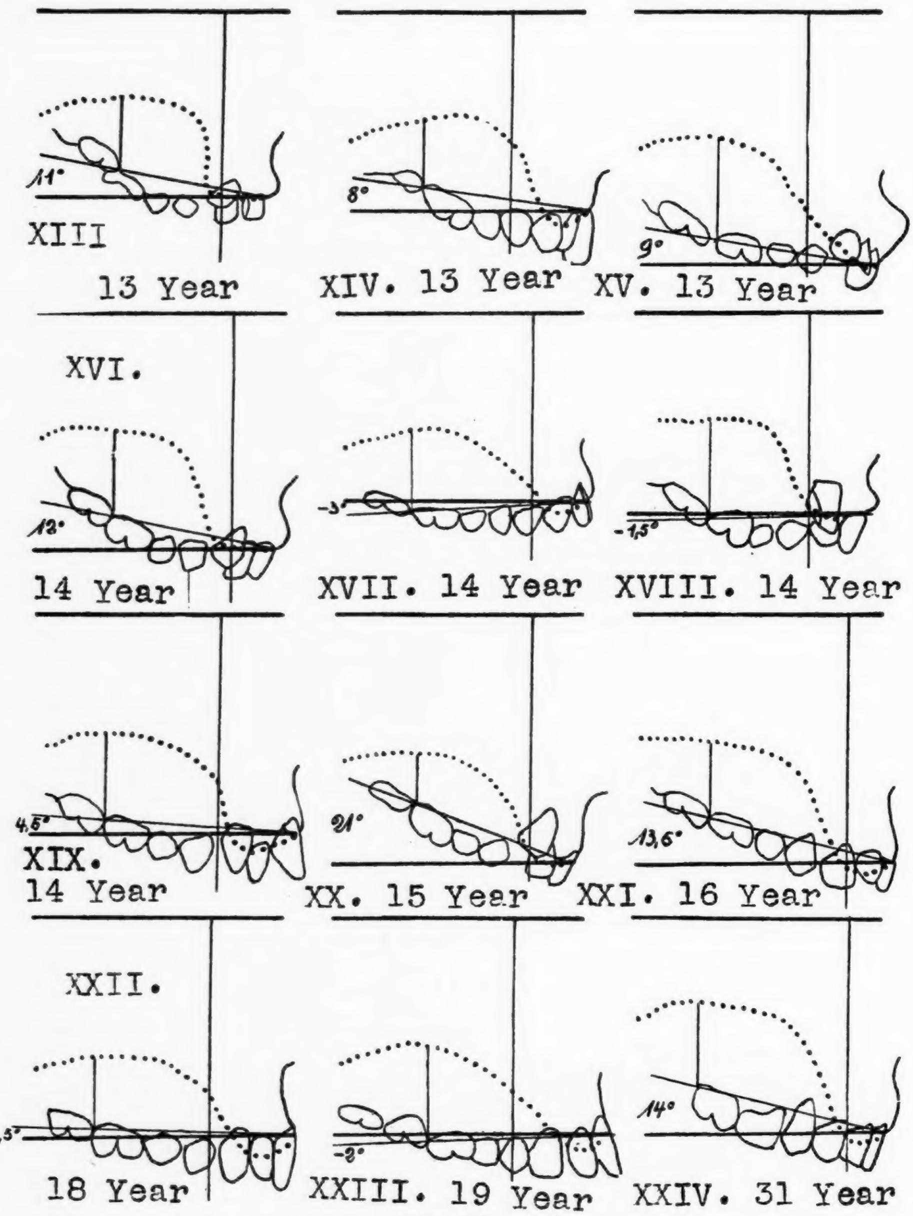

Plate III. . . . .

by the great length of the postauricular segments. It is of the dolichoid variety. In time to come both segments develop, the last mentioned until the ninth year of life approximately, the preauricular however, until the middle of the twentieth year so that the relationship of both parts of the measurements in many skulls gradually become reversed (Martin, p. 605).

In my diagram in Fig. 9, Part I, I can accurately measure the pre- and posttragial distances in the living being so that the erected perpendicular on the bitragial point portions off the length of the skull. In sixty-nine measured cases, five cases had their pretragial segments of the head larger than the posttragial.

THE RESULTS OF MEASURING IN REGARD TO ANGLE'S CLASSIFICATION

It is of special interest to figure out the most important acquired measurements with regard to the individual Angle classification, and to eventually be able to determine whether it shows a markedly big difference in development in regard to the several classes. (See Table XXXII.) The width measurements are very similar in all three classes. The measurements of the height show the following relation: The height distance of the first molar from the ear-eye plane on an average, agrees well in all three classes during the different age periods. The height of the upper part of the face is different. Where it is greatest in Class II, during the ages of seven to ten years, it is taken out of Class I during the second and third age periods. The height development of the upper part of the face is more intense in Class I; it amounts to 6 mm. The minimum height of the upper part of the face belongs to Class III. The maximum average palatal height is found in Class II, the minimum, in Class III. According to the length measurement, the length of the face when it is found in Class II, is greatest between seven and ten years, then follows into Class I, while the minimum face length is classed in Class III. Class I shows its most intense growth between the ages of seven and nineteen years. The difference between the first and second classes amounts to 5.4 mm. between the ages of seven and ten years, and but 1.6 mm. between the ages of fourteen and nineteen years. On the average, the distance between the first upper molar and bitragial point is greatest in Class II, and smallest in Class III. In Class II, this distance is 2.5 mm. greater than Class I, during the ages of seven to ten years, and 3.3 mm. greater between the fourteenth and nineteenth years. By this fact, it is seen that a disturbance in the mesiodistal relation of the first permanent molar is involved not only through restraint of the mandible, but also by the mesial and distal movement of the upper first permanent molar. The distance between the infradental and bitragial points in Class II, between the ages of eleven to nineteen years, is shorter than in Class I, the difference is not as great as we would expect; it amounts to 1 mm. It is important to note in Class III, that during the first age period it is 6.2 mm. greater, and in the second, 7.1 mm. greater than in Class I. It is important to note in Class II, that between the seventh and nineteenth years, we can hardly determine any growth. The average figures for the second year period are smaller than in the first. A retrusion of the jaw region of the mandible, which cannot be determined by measurements, can play a dual rôle. The variation of success in the regions of the jaw has been shown in my former work[6] (Part I). Greater differences are seen in the measurements obtained between the infradental and orbital points and between pogonion and bitragial points, projected on the ear-eye plane. The following are the average figures:

TABLE XXX

CLASS	INFRADENTAL BIORBITAL POINT	POGONION BIORBITAL POINT	NO. OF CASES
I	7.1	11.8	25
II	4.7	9.3	22
III	12.8	16.5	3
			50

The distance up to the orbital line shows a retrusion of the mandible in Class II, and a protrusion in Class III. However, by comparing the distance between the biorbital and bitragial points in the maxilla, it is seen that those in Class II are about 2 mm. greater than in Class I, during all the age periods, the length of the base of the head likewise remains stationary between seven and thirteen years of age. This lack of harmony between the mandible and superior maxilla does not lie only in the mandible but is dependent upon a greater or lesser length of the base of the head and of the face.

By comparing the distance between the infradental and bitragial points with the length of the base of the head, we form indices with this measurement scheme according to the formula.

$$\frac{\text{Nasion to bitragial point} \times 100}{\text{Infradental to bitragial point}}$$

and

$$\frac{\text{Nasion to bitragial point} \times 100}{\text{Pogonion to bitragial point}}$$

these last figures correspond with the mandibular index according to Siches and Krasa,[4] and produce the following averages:

TABLE XXXI

CLASS	NASION BITRAGIAL POINT X 100 / INFRADENTAL BITRAGIAL POINT	NASION BITRAGIAL POINT X 100 / POGONION BITRAGIAL POINT
I	115.4	108.0
II	117.4	111.1
III	106.2	101.4

In both formulae the maximum index is found in Class II and the minimum in Class III. The infradental and chin are somewhat retruded in Class II, and markedly protruded in Class III, in comparison to Class I. A summary shows the three following classes of development.

Class I, is the one which is most like normal development, that is the development energy increases all the measurements up to the nineteenth year instead of diminishing them. In Class II, on the contrary, a retarded growth is present in all the measurements as well as in the superior maxilla in Class III. A tendency toward macromandibular development belongs to Class III. The entire body has two marked periods of development, the first being between the ages of eight and nine years, and the second between thirteen and fourteen years. My measurements, for the greater part of the acquired head measurements, distinctly show that there is a very slight, or in fact a complete cessation of development between the eleventh and thirteenth years.

TABLE XXXII

HEIGHT AND LENGTH MEASUREMENTS

(Arranged according to Angle's Classification)

DISTANCE		CLASS I AVERAGE	CASES	CLASS II AVERAGE	CASES	CLASS III AVERAGE	CASES	AVERAGE FIGURES ACCORDING TO AGE	NO. OF CASES
N-Cent	7-10	63.3	8	64.5	7	62.0	1	63.6	16
	11-13	67.2	10	64.3	6	63.5	3	65.0	19
	14-19	69.3	8	68.4	15			68.9	23
Aver. Accord. Class	7-19	66.6	26	65.7	28	62.7	4	+5.6	58
N-bt	7-10	85.2	8	87.0	7	83.0	1	85.0	16
	11-13	84.5	12	86.9	6	87.4	3	86.2	21
	14-19	88.1	8	88.3	13			88.2	21
Aver. Accord. Class	7-19	85.9	28	87.4	26	85.2	4	+3.2	58
Pr-bt	7-10	79.3	8	84.7	7	78.0	1	80.6	16
	11-13	82.0	12	79.3	6	80.4	3	80.5	21
	14-19	84.2	8	85.8	13			85.0	21
Aver. Accord. Class	7-19	81.8	28	83.2	26	79.2	4	+4.4	58
Bt-bor	7-10	68.0	9	70.0	8	68.2	2	68.7	19
	11-13	66.5	11	68.4	9	67.5	3	67.4	23
	14-19	70.7	12	71.1	15			70.9	27
Aver. Accord. Class	7-19	68.4	32	69.8	32	67.8	5	+2.2	69
1stM-bt	7-10	40.5	7	43.0	6	38.7	1	40.7	14
	11-13	43.1	10	43.6	5	43.3	3	43.3	18
	14-19	44.0	7	47.3	13			45.6	20
Aver. Accord. Class	7-19	42.5	24	44.6	24	41.0	4	+4.9	52
Id-bt	7-10	73.3	7	75.0	5	79.5	1	75.9	13
	11-13	73.9	9	72.7	5	81.–	2	76.1	16
	14-19	76.2	8	75.5	12			75.8	20
Aver. Accord. Class	7-19	74.4	24	74.4	22	80.2	3	–0.1	49
Pg-bt	7-10	79.2	7	80.5	5	83.5	1	81.0	13
	11-13	79.8	9	76.3	5	84.5	2	80.2	16
	14-19	79.6	8	79.2	12			79.4	20
Aver. Accord. Class	7-19	79.5	24	78.6	22	84.0	3	–1.6	49

ASYMMETRY

Neither the normal head nor the remainder of the body shows complete bilateral symmetry, thus we must certainly expect asymmetry in heads with tooth and jaw anamolies. The new method of measurement enables us to determine this. Asymmetry is possible in all three planes of the body. It interests us from the standpoint of the condition of the orbits, tragi, and the raphe.

THE POSITION OF THE ORBITAL POINT. HORIZONTAL ASYMMETRY OF THE ORBITAL POINT

The orbital points are not of equal height, that is they lie in various relationship toward the horizontal plane—ear-eye plane. As the ear-eye plane has always been placed over the left orbital point, the abnormalities must be found in the right orbital point. Out of seventy-one measurements, fourteen times in 20 per cent, the right was higher; twice the right was 4 mm. higher than the left and three times it was 3 mm. higher, a difference of 1 mm. is not taken into consideration, thus we will pay no attention to it in our individual mistakes in measurement. Ten times the right was found below the left in 14 per cent.

The difference amounts once to 3.5 mm. and twice to 2.5 mm. Out of forty-seven children, 66 per cent have their orbital point at equal height. That a pronounced difference in height of one orbitalia can change the entire half of the face, is seen in Fig. 1, Plate I, in which the left orbital point, left nostril, left half of the mouth lie much below the right. The gnathostat models of these cases show that the asymmetry also affects the intermaxillary jaw as the left half and its corresponding teeth are likewise displaced. (Plate I, Fig. 2.)

TRANSVERSE SHIFTING OF THE ORBITAL POINTS

The orbital points do not lie in the same frontal plane. The raphe median plane, as well as the other planes, which from the nasion, is erected perpendicularly to the ear-eye plane, on the bitragial midportion, is marked as the median sagittal plane in our figuring and shows the following results in sixty-four cases.

1. *In reference to the raphe median plane* and one perpendicular to it, through the frontal plane laid on the biorbital points:

18 times = 28 per cent of the left orbital point, lies more anteriorly.
4 times = 6 per cent of the right orbital point, lies more anteriorly.
42 times = 66 per cent of both, lies in the same frontal plane.

2. *In reference to the nasion, bitragial median plane,* and one perpendicular to it, through the frontal plane passing through the biorbital point.

11 times = 17 per cent of the left orbital point, lies more anteriorly.
7 times = 11 per cent of the right orbital point, lies more anteriorly.
46 times = 72 per cent of both, lies in the same frontal plane.

SAGITTAL SHIFTING OF THE ORBITAL POINTS

1. The right orbital point in its relationship to raphe, median plane.

38 times = 59 per cent, the right side is further away from the raphe than the left.

8 times = 13 per cent, the distance of the left orbital point to the raphe is greater and

18 times = 28 per cent, both orbital points are equidistant from the raphe.

2. The right orbital point from the nasion, bitragial plane.

39 times = 61 per cent, are further away.
13 times = 20 per cent, the left are further away, and
12 times = 19 per cent, the left and right distances are alike.

The results therefore, show that the left orbital point and also the left orbit, lie nearer to the median sagittal plane than on the right side.

POSITION OF THE TRAGI

The horizontal distances of the tragi are not measured so we accept these two points in a horizontal direction as a constant.

TRANSVERSE SHIFTING OF THE TRAGI

1. *In reference to the raphe-median plane* and one perpendicular to it, through the frontal plane which passes through the bitragial points:

31 times = 49 per cent, of the left lie more anteriorly.
13 times = 20 per cent, of the right lie more anteriorly.
20 times = 31 per cent, of both lie in the same frontal plane.

2. In *reference to the nasion-bitragial-median plane* and a perpendicular to it through the frontal plane which passes through the bitragial point:

23 times = 36 per cent, of the left tragi lie more anteriorly.
16 times = 25 per cent, of the right tragi lie more anteriorly.
25 times = 39 per cent, both lie in the same frontal plane.

SAGITTAL SHIFTING OF THE TRAGI

1. *In reference to the raphe-median plane:*

32 times = 50 per cent, of the left tragi are further away from the raphe.
10 times = 16 per cent, of the right tragi lie further away from the raphe.
22 times = 34 per cent, are equidistant.

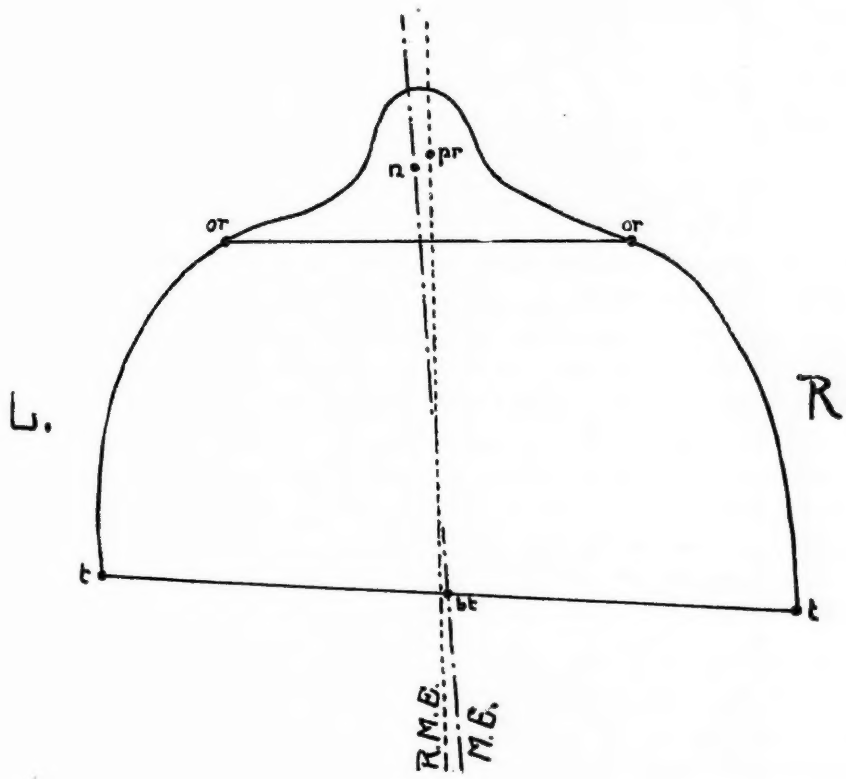

Fig. 6.

This signifies that the raphe in its relationship to the bitragial point, is shifted thirty-two times to the right, ten times to the left and twenty-two times it coincides with it. This deviation can be overcome in the region of the first molar or it can be compensated for by jumping over to the other side. There are cases however, in which both lines run parallel.

It is a known fact that no skull is so symmetrical that its geometric median plane coincides with the anatomic. Nevertheless, the other plane was accepted by Torok and Schrieber[5] as the geometric-median plane and it is perpendicular to the biauricular line. Van Loon also prefers this plane (sagittal porion plane), and refuses to accept the raphe as the sagittal plane. My measurement

in children with anamolies of the teeth and jaws, now shows an asymmetric relationship of the tragi in a transverse direction. To be sure that it may not be considered as a somewhat faulty measurement in my estimation, I have made five plaster masks, according to Van Loon's method, and from these I have sketched the horizontal curve from one tragus to the other by means of my stereograph, in the height of the ear-eye plane. In four curves, one from the nasion on the line falling in the center of the bitragial, stands perpendicular to the bitragial line, thus it shows a symmetric relationship. In the fifth plaster mask we find the established asymmetric position by marked shifting of the left tragus transversely, and the left orbit anteriorly. (Fig. 6.) The raphe-median and median planes of the heads cross each other. To obtain the last, I draw a line from the nasion to the middle of the bitragial and can now erect a median plane perpendicular to the ear-eye plane, with the help of this point. Due to transverse shifting of one tragus, it is not perpendicular to the bitragial plane. A transverse asymmetry of one tragus signifies a minimum variation for the median plane, a very important one however, when this plane is erected perpendicular to the bitragial plane, can easily be imagined by observing Fig. 6, after examining the plane closely. I wanted only the nasion and bitragial points as they appear to me as being the most positive. Points of the median line cannot be accurately determined on the cranial skull of the living being and the gnathion is often dislodged as the intermaxillary point during irregularities of the teeth and jaws. For orthodontia, it is only important to find the center of the face and not the center of the whole head, and this is attained by my method. Although my desired median-saggital plane has shown itself very suitable for the judging of the deviations, yet I must not reject the raphe-median plane which Korbitz introduced into orthodontia, as it has shown itself to be practical and sufficiently accurate. The study of these two planes has alone given us a sure clue to the abnormalities.

SUMMARY

The foregoing work is an experiment by which we obtain a clue to the development of the face in children with malposed teeth and anamolies of the jaws, with the help of the anthropologic method of measurement. The apparatus described in Part I was used for that purpose. The new stereograph performs a positive service in the study of the puzzling question of the skull, whether the problems are anthropologic, orthodontic, or articulation. It was previously used for such research work. With the help of my stereograph on the gnathostat models, we can obtain graphic results by means of our orthodontically taken measurements and make a map with it; the stereograph is thus an occlusograph at the same time. As all the models are surveyed on the ear-eye plane, these drawings have an entirely different value from those of Stanton. The very practical person will give preference to the simplest possible proceedings. He may use my gnathostat, the facebow without a bow part for the height and length of the head, and the chin cap without the gonion screw. The orbital and tragus screws are firmly embedded in the poured model, these can be trimmed according to these points, the posterior surface then forms the bitragial

plane, the superior, the ear-eye plane, and the under surface forms the gnathion plane. These particular distances can be measured on the plaster model, and be sketched on it. In this way, we obtain the most direct and most accurate transposing of the width, length, and height measurements. With the horizontal needle and contra-angle, and with the help of a symmetric scope, complete calculations can be made in all three dimensions. The value of these measurements is doubted on the ground that for orthodontia, the etiologic factors alone, are important. I believe however, by our exact measurements, we can, with this assistance, accurately localize the increased and retarded development, and be able to contribute toward a classification of etiology.

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FACIAL DEFORMITIES*

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THE other day, I saw a man selling false faces and the thought occurred to me, that a great many people were going through life wearing faces which did not belong to them. Nearly every child is born with a normal face which possesses certain characteristics that have been inherited from its parents. Many a fond mother boasts as to the beauty of her child and as the result of this belief, every mother thinks her baby is the most wonderful creation in the world. Because of the large number of beautiful children, we find baby shows are featured at country fairs and are even shown in movie weeklies. However, in spite of the many contestants, which make it difficult for the judges to choose the most beautiful child, we find later in life that the difficulty of selecting bathing beauties is less of a problem. The great difference between the number of beautiful babies and the number of handsome adults is because, somewhere during the process of growth and development, the beautiful baby is forced for some reason or other to assume a face that nature never intended it should wear.

Mother's "beautiful angel" becomes lost in a group of homely faces that have not had a chance to develop properly because the proper attention and care has not been given to the child during the growing period.

These facial deformities may be only slight or they may be so extreme as to present a face with very little resemblance to human form. The majority of these extreme facial deformities have only a small beginning and if taken early in life they are very easily corrected or may be prevented entirely. It is indeed unfortunate that the majority of unpleasing faces which we see on the streets, in theaters and subways could have been prevented or at least corrected very easily if the parents had possessed the proper knowledge in regard to the possibility of having these deformities corrected. We have stated that nearly every child is born with a normal face and this statement can be enlarged to say that practically every child has a normal face up to the time the deciduous teeth or baby teeth are developed. In other words, inheritance tends to produce a normal face but certain environments tend to produce deformities. By environments, we mean those conditions over which the individual or the human family as a whole has some control.

Facial deformities seem to be on the increase because the majority of them are associated with malposition or maldevelopment of the teeth. We have often been asked as to the cause of so many facial deformities or malocclusions, and the answer is that at least 80 per cent are the result of "civilization." This may sound rather a cruel statement, to accuse civilization of producing facial deformities, but nevertheless it is true, because civilization

*A health talk, broadcast from WEAF, New York, February 19, 1925.

is controlled by organized society and organized society has brought about conditions which are detrimental to the normal development of the teeth. We might change the word "civilization" as the cause of malocclusion and substitute "disuse," which, from a biologic standpoint, means that any organ in order to be developed must be used. Civilization is again responsible for disuse because the type of food which the average youngster eats is so prepared that it is unnecessary for the child to masticate its food, consequently about the time the deciduous teeth have erupted, the lack of use has brought about malocclusion of the teeth and lack of development of the face and jaw, which produce a very noticeable deformity later in life. Other evil defects of disuse which have a bearing upon facial deformities are improper food, and the teeth are not properly cleansed and consequently decay early and are often extracted before they should be. The early loss of the deciduous teeth results in a lack of development of the bony structure supporting the teeth and in turn again produces facial deformities.

The early loss of the deciduous teeth in the maxillary arch often results in the permanent incisors taking a position behind the mandibular incisors. At this time in life, the deformity is not great and can be very easily corrected. However, if the position of these teeth continues to remain abnormal, the use to which the teeth are placed results in an overdevelopment of the mandible; the chin becomes prominent and we have a great facial deformity which is very unpleasing and difficult to treat later in life. It is also true that extreme facial deformities are often produced by seemingly innocent habits. Thumb-sucking and the use of pacifiers may produce protrusion of the maxillary teeth and lack of development of the mandibular arch, which again produces a facial deformity familiar to all. It is that type in which the maxillary front teeth protrude to such an extent that the first thing you see when you meet a person is the front teeth. These deformities are also associated with abnormal breathing because it is an established fact that the mouth breather presents a deformity of the face that is well known to medical men.

Mouth breathing is often produced by the hypertrophied lymphoid tissue located in the back part of the nose, in what is known as the nasopharynx. The development of this lymphoid tissue closes the nasal space and the child is forced to breathe through the mouth. You may think that it would make little difference in regard to the face whether the child breathes through the mouth or nose, but we find there is a great difference in the act of breathing which is responsible for one of the most unpleasing facial types. In order for the nose and the upper part of the face to develop, the air must pass through the nasal cavity, which by so doing exerts a stimulating influence on the tissues lining the nose and also exerts mechanical pressure on the lateral walls of the nose which cause the nasal cavity to develop laterally, anteroposteriorly and vertically.

In the nasal breather, the mouth is kept closed and the tongue occupies the whole of the oral cavity; also as soon as we cease speaking, if we breathe through the nose, the mouth is closed and the individual unconsciously swallows, which brings the soft palate and tongue in contact with each other and

a vacuum is created between the roof of the mouth and the tongue. As a result of this vacuum, the mandible is held in its correct position and assumes its proper function, thereby causing the mandible and chin to develop as they should. If the individual is a mouth breather, facial deformities develop; the maxillary dental arch remains very narrow because the tongue fails to exert any lateral pressure on it; the lips separate so there is no restraining influence on the maxillary front teeth and consequently they protrude. This protrusion is made worse because the lower lip drops under the maxillary incisors and forces them forward. The lower jaw drops downward; the muscles of the neck and throat sag because of the loss of atmospheric pressure; the chin remains undeveloped and in extreme cases, we have a facial deformity which gives the individual the appearance of having swallowed his chin. It is probably from this type of chinless individual that the famous cartoon of Andy Gump originated. The early appearance of this type of facial deformity may be slight, but if the abnormal breathing continues, the deformity increases as the individual grows older.

It is this type of facial deformity which has been charged to inheritance, because one individual so greatly resembles another; consequently if these facial deformities are present in any member of the family, it would be very easy to consider that the deformities had been transmitted. As a matter of fact, the child resembles "Aunt Mary" only because "Aunt Mary" and the child have been subject to the same pathologic conditions and consequently have developed the same type of facial deformities.

Another very common cause of deformities of the face is the use of nursing bottles. It has been proved by careful examination that 80 per cent of the bottle-fed babies suffer from facial deformities. This is because of the persistence of the sucking habit carried over a longer period of time. If the child is allowed to suck on rubber nipples, he fools himself, and consequently while he is fooling himself he fools his parents by developing a facial deformity.

We have previously spoken of food as playing a part in production of malocclusion because it is often prepared in such a way as to make it unnecessary for the individual to masticate. The faulty diet not only produces malocclusion and facial deformities but it fails to supply proper nutrition to the individual and consequently systemic disturbances arise, which also influence facial developments. These deformities are more to be regretted because they are the result of civilization and can be entirely eliminated by proper control and proper cooperation on the part of the parents.

Orthodontia is that science which has for its object the correction of malocclusions of the teeth. Malocclusions of the teeth are various malpositions of the teeth which interfere with function and development. The teeth have various functions in the human family and it is only when the teeth occupy their normal position that we can expect the child to develop a normal face. Orthodontia can do more to correct the terrible facial deformities and maldevelopments that we see in every walk of life than any other science. Individuals with protruding teeth and deformed jaws, that almost destroy every resemblance to the human face, could have been successfully treated during the period of growth. The proper treatment of the facial deformity changes

the person from a wallflower to a social ruler. The amount of benefit that can be done for such people is only limited by the age at which the treatment is begun.

The correction of facial deformities should always be undertaken as soon as any variation is noticed. The process used in correcting those facial deformities is one of controlling and stimulating the growth of the various parts of the face so as to supply by treatment that which nature has evidently failed to produce.

Malformations of the face always begin by a small deviation from the normal. As a result of this variation, the functions are interfered with and the condition becomes worse as the individual grows older. To obtain the greatest benefit from orthodontic treatment, the child should be taken to an orthodontist as soon as any deviation from the normal is noticed. While orthodontic treatment offers the greatest possibilities for the child, it must not be forgotten that many deformed faces which we see in adults can be greatly benefited by proper care. Wonderful results have been obtained after adult life, but the treatment extends over a longer period and the normal facial outline is not always obtained, although greatly improved.

If your child is not as beautiful as you think he should be or if you have noticed the face becoming less pleasing than formerly, remember that orthodontic treatment is the science that is able to correct this maldevelopment and give your child the face that nature intended he should have.

MALOCCLUSION OF THE TEETH REGARDED AS A PROBLEM IN CONNECTION WITH THE APICAL BASE*

By Axel F. Lundström, Stockholm, Sweden

(Continued from October)

III. Criticism of the Data Used as Evidence to Prove the Present Theory

1. ARGUMENTS SO FAR PUBLISHED NOT INCONTROVERTIBLE

In the foregoing have been described momenta of malocclusion which were characterized as underdevelopments of the apical base. To these belong amongst others bimaxillary crowding and opistognathism. Treatment of malocclusion with its various forms of deficiency in the apical base had already in 1900 been based by Angle upon the attainment of normal occlusion, and many of his successors have with vast energy endeavored to attain this result. It has, however, been evident that after such treatment in these cases there often remained an inclining position of the corrected teeth, due to the fact that sufficient space between the roots, i.e., according to the terminology employed here, an adequately large apical curve was not at once attained. Through some quite remarkable cases treated by Angle, it was found that this condition could be compensated by a spontaneous development taking place later on. However, this did not always happen, wherefore Angle, with a view to improving the condition, invented the "working retainer," and the treatment was modified, with the idea of affecting the apical base actually during the moving of the teeth.

My own attempts—to be dealt with below—at moving the roots by this method have convinced me that it is not the appliance but rather the capacity of natural growth of the apical base which decides whether a permanent normal occlusion can be achieved. The best results with the working retainer are no better than those treated with the ordinary expansion arch. Nor do the published results of what others have effected in this connection seem to me to establish the necessity of apical expansion. How these results finally developed it is of course impossible for me to judge, but, judging from the available published material, i. e., in the first place from the reproductions of casts, I cannot find that they offer any proofs. We shall, therefore, examine the cases that have appeared in literature, and from them it will be seen that the support they give to the desirability of a mechanical apical expansion is not clear. Afterwards shall be presented the result of some of the attempts made by me with an ordinary arch, and also some others in which an arch having a direct apical effect was employed.

In the second German edition of Angle's textbook on orthodontics,[6] there

*Reprinted from *Svensk Tandläkare Tidskrift,* 1923. References will be published at end of article in last installment.

is to be found (p. 690, Fig. 712) a reproduction of the first case treated with the working retainer; in Fig. 713 is represented the result of making a correction with the ordinary arch, and Fig. 714 the result of 6 months' action by the said retainer. The inclination of the upper incisors is in a considerable degree corrected. But no illustration has been given of the condition some time after the removal of the apparatus. It is to be observed that the working retainer is not a retainer in the original sense, but a regulating apparatus. It was pointed out long ago that for an orthodontic result to be considered definite it must be proved that the new position of the teeth was maintained after the removal of the retainer. It is a well-known fact that by the action of orthodontic treatment we can make teeth temporarily adopt entirely different positions from those which we are afterwards capable of maintaining. What has been published on the case here mentioned can, therefore, not be accepted as proof.

Out of his working retainer Angle developed his "pin and tube" apparatus in order to be able to influence the apical base right from the beginning. The first treatment with this method was carried out by Ketcham, and the result was published in the *Dental Cosmos* of 1912 and 1913. The result of the treatment was shown in the quoted edition[6] (Fig. 721), and is excellent, but as no very long period elapsed between the time of the removal of the apparatus and the taking of the final impression, the illustration does not offer sufficient proof. Nevertheless, it does seem as if the result had in this case been of a permanent nature. For the type of the case is such that we can expect a normal apical condition even after treatment without special root-movement. It appears from the illustrations that the inclination of the central incisors before treatment was not so disadvantageous, since the contraction was only in a small degree an apical one. Thus no increase in the apical base worth mentioning is found to be necessary in this case. Further, in this case the crowding was confined to the upper jaw, so that it was no bimaxillary crowding and it is just in these bimaxillary crowdings that the expansion of the apical base is most desirable. If we compare with this case, another in the same book, Fig. 426, we there find a more difficult case treated with equally good results merely with the aid of a common tipping expander. Angle says in the same work (p. 692) regarding the moving of roots with the new apparatus: "If the normal growth and the full development of the bone and the other tissues has been attained through this expert assistance, the further prognosis of the case is always good—provided in other respects normal conditions." This is indeed a very important reservation. In my experience we so often come across cases in practice in which such "in other respects normal conditions" do not obtain that what is here said of the treatment cannot be considered of sufficient general acceptability to be set us as a rule.

Of interest are the results of two cases recorded in the same chapter of the work quoted, the one treated by Ketcham, Fig. 722, and the other by Grünberg, Fig. 741. Neither of these cases offer anything remarkable, and to me there seems not the least doubt that equally good results could have been obtained without special root movements.

Finally, there appears illustrated in the same work a case treated by Ketcham, Figs. 728 to 736, in which the illustrations show an apical expansion which probably could not be obtained with the ordinary expansion arch. As mentioned in the foregoing it is very easy to get teeth in positions that cannot afterwards be maintained. The final illustration from this case shows the condition "at the end of the treatments." That is not sufficient. To represent complete proof a cast should have been made showing the condition a considerable time after the final apparatus had been removed, in order to prove that the orthodontic maximum had not been exceeded.

Another interesting attempt to expand the apical base has been published by Young,[93] an acknowledged expert in the handling of the pin and tube combination. Here too the final result is wanting, but so much is to be gathered from the description, that the apical expansion went on for two and a half years. In the handling of another case the active treatment took a long time, and after that the apparatus was applied for a year as a retainer, but after the removal of the apparatus the result was not fully maintained, the author considering that it would be necessary to apply the apparatus once more. It would have been interesting if the author had submitted a report on the further fate of the case. I am inclined to assume that the treatment involved what I have called exceeding the orthodontic maximum, and that consequently the result could not be maintained.

We shall now proceed to some cases in which the apical development at the beginning of the treatment was poor, and in which, therefore, the moving of the roots would appear to be indicated in order to produce a normal occlusion. However, no attempt of this kind was made, the treatment being carried out only by the old expansion method. It appears that a considerable apical expansion took place later on, but only as a consequence of the general development of the individual concerned (Figs. 57, 58, 59, 60, 61. *See October issue*). Of course, a similar result could have been obtained in this case with an appliance for root movement, but it would be misleading on the strength of this result to ascribe to the mechanical apical expansion having produced it.

Figs. 63 to 65 show a case in which lengthy apical treatment with pin and tube failed to make the teeth remain in such an inclination to allow of a normal occlusion being maintained, Fig. 64 showing the immediate result, and Fig. 65 the result 4 years later.

In the case of Fig. 62, the difference between the orthodontic maximum and the normal curve was so great that in spite of early treatment and a lengthy retention period, it proved necessary to obtain by means of extraction a more suitable relation between the apical base and the coronal curve.

As before mentioned, Case, in spite of his refusal to accept the idea that the attainment of normal occlusion will without exception effect an enlargement of the apical base, may nevertheless be considered as the one who in practice was most convinced of the power of the teeth and occlusion to affect same, since in certain cases he effects an expansion in a sagittal direction beyond the normal size. In his latest textbook[17] he has certainly given exact and detailed information on how he carries out his treatments, but if we

critically examine the results he has published, we find that he has not selected this material in such a way that it proves the permanency of the results of his treatments.

Out of twenty-seven cases which are of interest in this connection there would be, according to Case's statements:

	CASES
Failures in	3
The retainer still in position or the case ready for the retainer	6
No information as to the point of time for the final model	12
Vague statements, as "without doubt"	2
Inaccurate models	1
Insufficient time elapsed to be able to prove whether the case has succeeded	3
	27

The theory upon which the mechanical orthodontic treatment of abnormal positions of the teeth has been based is, therefore, wrong. It has been based on practical tests. Successful results in some cases have led to generalizations upon methods of treatment. The generalized method of treatment, which aimed at the attainment of normal occlusion, has not been proved reliable.

In orthodontics, then, we have now arrived at a state of experience very similar to that which a close-related medical art reached not very long ago. On this Roux says: "Practice, it is true, comes before theory in point of time; the latter is afterwards built upon the basis of those facts which have already been gathered from practical experience." And he mentions the immense progress of technique since the pure empirical period was left behind. "It certainly reminds the surgeon very much of the history of the orthopedic methods of treatment. How many thousands of children with club-foot, contraction of the joints, etc., have not had to struggle through their youth in consequence of a false idea of the cause of the disease and the effect of the means adopted founded upon useless apparatus, before the innumerable cases of failure have gradually led to a deeper insight and to more serviceable apparatus." Every orthodontist who has for many years conscientiously based his treatment on the doctrine of the normal occlusion as its objective will find a surprising similarity between this empirical period of orthopedic surgery spoken of by Roux and the last two decades of orthodontics.

It would, however, be utterly wrong to accuse the practitioners of orthodontics of having neglected to try to ascertain the causal connection between the natural or artificially attained normal occlusion and the masticatory function. On the contrary, many attempts have been made to give a theoretical explanation, and investigators have even sought by means of experiments on animals to prove this connection. In what follows these explanations will be subjected to criticism and an attempt made to show that they do not serve to support the therapy prevalent today.

2. THE SUPPOSED EFFECT OF FUNCTION UPON THE ARCH'S DEVELOPMENT TO ITS NORMAL FORM

Since a number of crowdings in the denture were observed to be simultaneous with an arrested development of the base of the arch, and many exam-

ples were known of an insufficient development of an organ being the result of a subnormal function, it was easy to draw the conclusion that a crowding of the teeth was also due to a similar factor. A very large number of authorities have declared themselves for this view. It would take too long to prove this with quotations. Nor indeed is it necessary, as only a few have attempted to prove their statements.

The influence of function upon an organ's development has long attracted attention and is to a certain extent a well-known fact. It may be of interest to touch upon this question in a few words, and to give as brief as possible an account of opinions hereon, as are entertained by Roux.

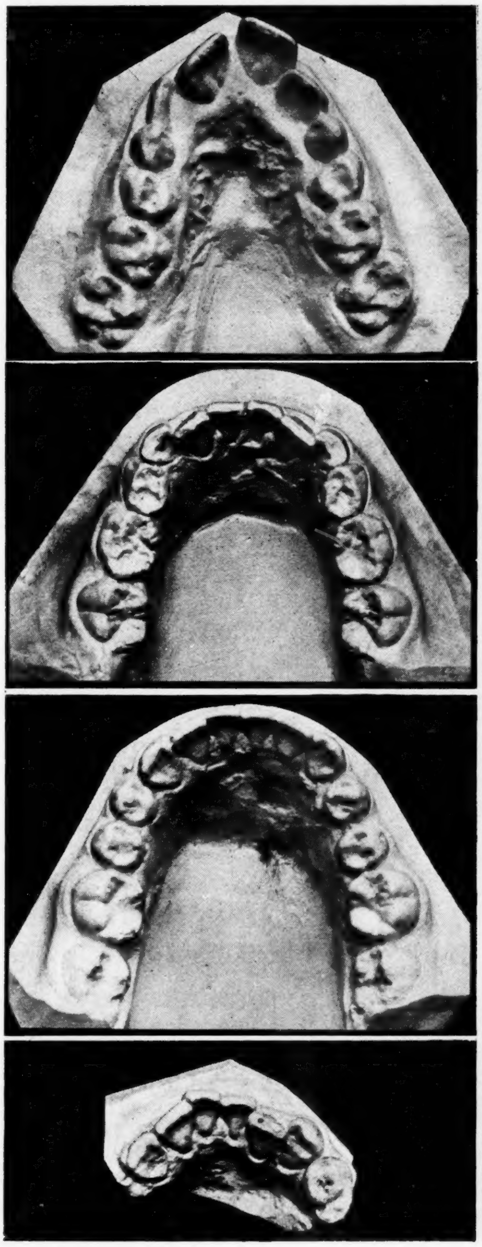
Roux differentiates between two kinds of form-development, the purely hereditary, nonfunctional or prefunctional, and that evoked by a stimulus to function. The former takes place before the individual's organ in question has begun to function; the latter is closely associated with function, and consequently is absent if no such function has been exercised. With reference to the different periods of an individual's life during which these two kinds of development of form take place, Roux has assumed four "causal periods."[74] During the first the nonfunctional development goes on relatively unmingled, and gradually declines during the following periods. Nevertheless, it is to be observed that these periods are not sharply defined, but both species of development exist during them all.

As far as the functional form-growth is concerned, Roux' explanation, according to C. Herbst[35] (p. 626), of the structures that develop in the course thereof is as follows:

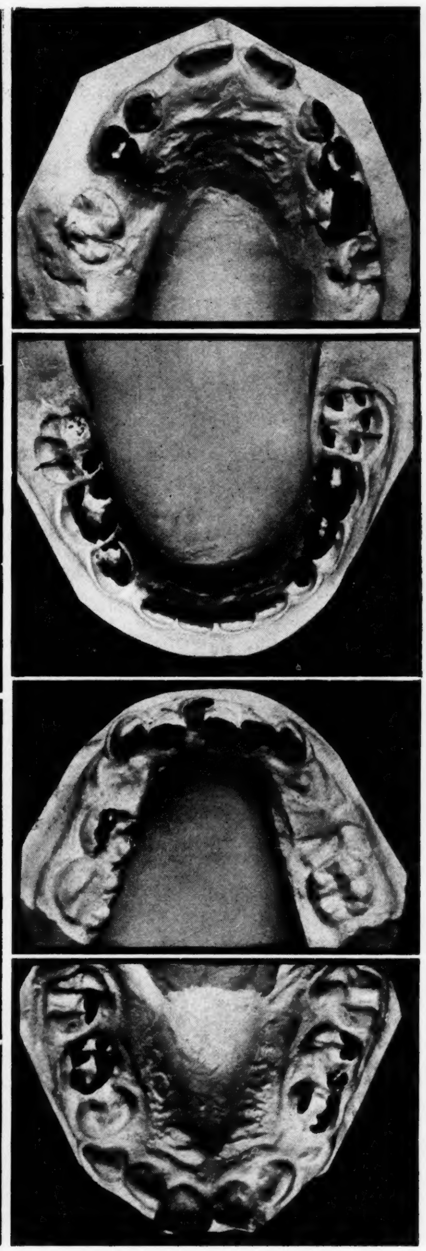
"Roux starts with the well-known fact, in regard to functional adaptation, that an organ's functioning places it in a better position for exercising its function, while a deficiency in that respect makes it less adapted, and he attempts to explain this functional adaptability by the assumption that the exercising of the function produces a trophic stimulus in the functioning elements, whereby these develop and increase in number, with hypertrophy as a consequence." The functional hypertrophy consists of the development of an organ or a tissue, this development following various laws according to the character of the tissue or organ concerned.

Since it has been proved that muscles and bone, etc., are influenced by function, it is to be expected that an intensive function has the power to stimulate to a hypertrophy of activity, and that a weaker function results in an atrophy of inactivity, also where the masticating apparatus is concerned. But it need not follow that this atrophy of inactivity is likely to manifest itself in a crowding of the denture, or that the difference in functional activity which might possibly be demonstrable between for masticating differently well adapted dentures, is sufficient in the one or the other case to manifest itself in different degrees of crowding, or in and in other respects abnormal apical base. Nevertheless, it is just this very idea that prevails, not only amongst the supporters of the occlusional theory, but also amongst other authorities who cannot be placed in the category of practical orthodontists, such as Franke.[25] In accordance with Roux' idea of non-func-

tional and functional form-development, Franke states with regard to the causes or the growth of the jaws that this proceeds "in accordance with a building plan of its own within the bounds of an hereditary stimulus to development."



Figs. 62, 63, 64, 65.



Figs. 66 and 67.

But in Franke's view this is not sufficient, but this development will remain incomplete if not assisted by the masticatory function. Failing this, or if the support is not sufficiently intensive, deformities of the jaws and abnormal dentures result. The masticatory function, therefore, should be what in Roux' terminology is called a "factor of realization."[75] What Franke calls "building

plan" could not be realized without a certain degree of masticatory function.

Franke has reached this result by examining the direction of stress which the maxillary bones have to sustain during the masticatory function. He finds this stress stimulates a lateral development in the upper arch and a longitudinal development in the mandible. The abnormal insufficient width of the upper jaw in cases of mouth-breathing is not due to the air not passing through the nose, but is caused by mastication being rendered more difficult by this form of breathing.

Lateral development of the upper arch is rendered possible, according to Franke, in accordance with "the law of conformity of aim," so that a bone, which is subjected to a greater stress, develops at right angles to the direction of pressure. In consequence thereof the upper jaw must also develop in breadth. This development takes place in the median palatal suture. But since a development of breadth in the lower jaw cannot be explained in the same way, he makes this development appear as a result of that proceeding in the median palatal suture, assisted by the articulation of the teeth. The development of breadth in the arch of the lower jaw would thus be rendered possible through a, so to speak, orthopedic factor (see Franke's Fig. 20).

It appears from Roux' writings that it is a difficult thing to determine the extent of the various causal periods, since they do not coincide in the case of all organs, not even for the same organ in different individuals. As far as the dental arch is concerned, this fact is well-known to orthodontic authorities, seeing that, as has been stated before, a spacing in the temporary denture stage is not invariably accompanied by a normal permanent arch, just as an abnormally slight spacing, with an initial lack of space for the permanent teeth, may be followed by an adequately compensating development in a later stage (Figs. 33, 34). Since also—according to Roux—it may happen even as late as during the third period that the function confines itself to determining the structure in its adaptation to the shape of an organ acquired by heredity, further difficulties arise in deciding a priori the degree in which a well developed arch is to be regarded as the result of prefunctional or functional factors.

Franke's opinion, that the lateral development of the lower arch is a secondary result of development in the median palatal suture, is improbable. All orthodontic experience goes to show that only with apparatus especially constructed for bodily movements, is it possible to carry out a parallel expansion of the dental arches. Pressure exerted upon the cusps alone would only cause a tipping. Besides, experience has proved that pressure on the teeth only alters their position, but no proof has ever been forthcoming that this pressure extends its effect beyond the sphere of the apices. In order to have a development of breadth in the lower arch simultaneously accompanied by the development of the entire lower jaw we must presuppose for the purpose an independent growth in that jaw. Now, were it the case, as Franke states, that the lateral development of the lower arch cannot be explained on the basis of functional adaptation, i. e., in this instance as a result of the masticatory function, then it must be assumed to be nonfunctional.—A further objection to the supposition that a lateral growth of the arch of the lower jaw is a result, assisted by articu-

lation, of an apposition of bone in the median palatal suture, is to be found in the fact that in certain animals such articulation is wanting. For instance, in the case of certain Felidae all the cusps of the lower jaw occlude lingually in relation to the antagonizing teeth. A lateral growth having such an effect in the case of the upper jaw and showing passivity in the lower jaw of the kind assumed by Franke would in these animals lead to impossible conditions of occlusion.

That organs may become fully developed to a high degree of functional capacity during a period in the course of which they have not had an opportunity of exercising their function is well known. Thus Hopewell-Smith[38] has drawn attention to just this point in regard to the shape of the teeth. Although the crowns are fully formed before dentition, they have a shape that is particularly well adapted to functioning with the antagonizing teeth. Seeing that such a perfect adjustment of several organs to each other is possible without functioning during the development of the individual, no surprise need be felt that the entire arches may develop so as to correspond without special functioning. This is the case with reptiles, which already at birth are equipped with a biting apparatus, which only differs from that of the full-grown creatures in size, but is equally serviceable in functional capacity, if regard be had to the smaller dimensions. We thus have examples of a fully developed, functionally effective jaw apparatus which has been formed without ontogenetic functional adaptation, from which, however, it does not follow that such a phenomenon will take place in man. In order to prove this latter assertion entirely different facts must be adduced.

The common occurrence of deeply abraded teeth in races in a lower state of civilization and in the remains of ancestors of recent civilized races, the common occurrence in the same categories as those mentioned of regular arches with normal apical base, these facts combined with the cases of narrow dentures, often observed amongst cultured peoples both of the present and the past, have caused several authorities to draw the conclusion that the narrow dentures are the result of inadequate masticatory functioning. Thus Hawley[34] states with regard to Indian children: "From the age of six to twelve I found nearly fifty, and as near as I can determine you can call practically every one of them normal across the first molar, indicating that from the age of five to ten and twelve there had been great development, far more development than in our children. I noticed also that the cusps of the temporary teeth were worn absolutely flat, and many of them half way to the gums, and we could fairly draw the conclusion that the development was due to use in mastication." Here existed an intensive function manifest through abrasion, but it does not follow therefrom that the development is a consequence of the function. For if it were the case that a normal development was dependent on a function of an intensity that manifested itself by the extensive abrasion, then in those cases in which no such abrasion is to be found in normal conditions in respect of the size of the apical base would not be found. But that there may be full harmony between the apical base and the coronal curve, at the same time as no signs of intensive function are manifest in abrasion, has probably not escaped the notice of observant

dentists. And in practically every modern textbook of orthodontics there are to be found reliable reproductions of such cases.

But cases showing that the development of the apical base is not a necessary consequence, even where the masticatory function has been intensive, are not difficult to find. The case shown in Fig. 66 was characterized by an abrasion of the second temporary premolars, which gave clear evidence of an intensive function. In spite of this it developed into bimaxillary crowding. Fig. 67 likewise shows traces of an intensive function, but the apical base of the upper jaw was none the less narrow. On the other hand, that of the lower jaw was too wide and stood in mesioclusion. (The abraded surfaces are colored in black in order to bring them out more clearly.)

Evidence against the theory that the disharmony between the apical base and the mesiodistal approximal length of the arch is due to an inadequate function is found in those frequent cases in which the apical base of the one arch is normal and the other subdeveloped, as also a number of forms of malocclusions, in which to all appearances the function is rendered difficult but the apical base is well developed. Figs. 43 to 45 show a case where, in consequence of a distoclusion combined with the early loss of all the first molars and traumatic overbite, the functional capacity is seriously reduced. The cutting edges of the upper incisors have for many years irritated the labial gingival margins of the antagonizing teeth. The labial surfaces of the roots of the lower incisors are exposed to the extent of 6 mm. The upper apical base, however, is in harmony with the size of its teeth. The "ererbte Wachstumsreiz" of Franke has in this case been proved to dominate as far as the apical base of the upper jaw is concerned, in spite of what is, as far as one can judge, a considerably reduced masticatory activity. Fig. 8 is a case of opistognathism. The apical base of the upper jaw is, therefore, very insufficiently developed, while that of the lower jaw may be regarded as normal. Fig. 37 has a very narrow palatal arch (the distance between the second temporary premolars is 22 mm.), while the apical base of the lower jaw was at the time normal. (Fig. 38.) Now assuming a certain intensity in the function of the teeth as essential for a normal apical base, without which the latter will not develop sufficiently, we must presuppose a similar intensity in these cases, for otherwise the apical base of the lower jaw would not be able to attain normal development. But the upper arch has been subjected to the same stress. It follows from this that an arrest in the development of the apical base may be due to other factors than a reduced function.

In the occlusional anomalies here described the size of the apical base is independent of the masticatory function; it should be added, however, that some such function must be assumed to have taken place, and we are not justified in drawing from these cases such a conclusion as that the apical base would not have had its development arrested if no stress of mastication had been possible. As to the question whether a complete absence of masticatory pressure affects the apical base or not, opinions differ.

Federspiel[24] relates a case in which, in spite of the congenital absence of a number of teeth the jaws developed to normal size. Most authorities, however, consider that lack of mastication produces an inadequate or deformed develop-

ment of the apical base, and some go so far as to ascribe great importance to mastication not only in respect of the region next to the teeth, but also more distant parts; indeed, there are even those who consider that it exerts an influence on the development of the brain itself.[9]

Baker's experiments. In order to investigate by experiment the influence of the absence of mastication on near and distant surrounding regions Baker[8, 9] has carried out a number of experiments on rabbits, sheep, dogs and cats. He succeeded more or less completely in destroying the power of mastication on one side of the denture by grinding down or extraction of the teeth. From this a number of changes took place. In certain cases, e. g., in an experiment on a dog, a high degree of asymmetry developed, somewhat reminding of Walkhoff's[81] result after the removal of one of the musculi temporales. In spite of the functional disturbance brought about by Baker's operation, which must have been considerably more radical than what may be supposed to have taken place in a crowded denture, it is not possible to discover from the published results any deduction in the lateral breadth of the palatal arch worth mentioning, if any at all. One of the experiments on dogs was carried out in such a manner that only the upper teeth on one side were extracted. Hereby the half of the lower jaw on that side was put out of function, but it is not clear either from Baker's description or from the illustrations that any disturbance resembling a crowded denture could be discovered in the lower jaw. It should further be noted that in the experiment on a cat, in which the teeth on one side of the lower jaw were extracted, the difference between the mandibular bones is considerably greater than in the experiment on the dog, in which case only teeth occluding with those of the lower jaw were extracted. It seems probable, therefore, that it is not only the absence of function but also the greater loss of tissue with accompanying contraction, that is responsible for the change. In the experiments on sheep and rabbits no extractions were made, but the teeth were ground down. But it is to be observed that in these animals the teeth in question are hypsodont, which implies that a long time elapses before the roots are ready-formed, wherefor we would expect a greater effect of the grinding than if this were carried out with animals with bunodont teeth.

One fact, which confirms the view that the loss of tissue caused by the extraction of teeth has here effected the development of the lower jaw, is the disturbance in the latter which can often be proved after loss of teeth in man (Figs. 68, 69). In such cases the degree of distoclusion is considerably greater than what is possible when all the teeth of the lower jaw are intact. It might be considered difficult to decide whether it is the loss of substance *per se* or the resulting inadequate function which determines the result. The various results of Baker's experiments with extraction of the teeth of the lower jaw and of their antagonizing teeth indicate its being the loss of substance.

From what has been said in the foregoing it is clear that the idea that inadequate masticatory function gives rise to anomalies in the denture is, therefore, as far as the conditions of an abnormally narrow apical base are concerned, not well founded. We have on the contrary every reason to suppose that the difference in stress which might possibly be shown to exist between cases with normal

and those with abnormal apical base, is not sufficient to explain the difference in this respect, and that in the arch's development to normal size the prefunctional development dominates to such an extent that in an individual who is normal in all other respects but in the intensity of the masticatory function, there is every prospect of a normal condition in the apical base being developed.

Landsberger's experiments. In order to ascertain the influence of the teeth on the development of the skull Landsberger[47] removed the germs of both the temporary and permanent teeth of dogs. These operations effected remarkable changes in the form of the skull. In discussing the cause of these alterations Landsberger states that it presents considerable difficulties to attribute them to the elimination to the pressure of mastication, as the removal of the lower teeth did not affect the development of the upper jaw. He attributes to the developing teeth an expanding influence. With the removal of the tooth germs this expansive force is lost and the operated jaws give an "impression of atrophy." From his illustrations it appears that the arrest in development is very noticeable in those parts especially connected with the muscle attachments, but the

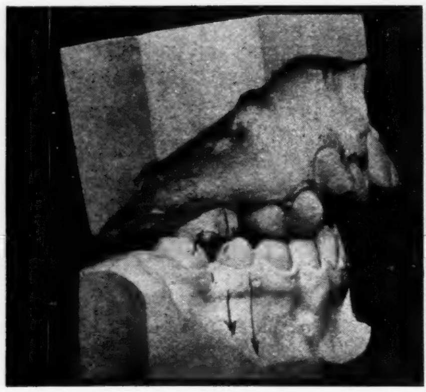


Fig. 68.

Fig. 69.

apical base iself is only to an inconsiderable degree affected, and shows far less deviations from the normal than often is the case in certain forms of malocclusion where the full complement of teeth is present. The total destruction of the masticating power, brought about before the eruption of the teeth, not being capable of effecting any considerable change in the apical base, is extremely improbable that the reduction in masticating function, which might be demonstrated in certain cases of abnormal apical base with no teeth missing, should cause a greater change than the extensive operations described by Landsberger.

Rogers' experiments. Rogers has attempted by experiments on patients to confirm the theory that the masticatory function is essential for the development of a normal occlusion, and the results of these experiments are published in three articles.[70, 71, 72] He begins by accounting for the fact that, according to Angle and Dewey, amongst others, certain "natural" forces are necessary for normal occlusion, among which is to be reckoned also muscular pressure. He also states that "our teachers have recognized the importance of muscular pressure in its normal conduct as well as in its abnormal conduct, but here they seem to have stopped, assuming that with the correction of the fautly osseous forma-

tion. Nature, somehow or other, would establish the correct muscular tone and muscular habits.''[71] He believes that it is necessary, with the aid of certain exercises of special muscle groups, to bring about the development of those parts which show inadequate development in cases of malocclusion. In the articles quoted Rogers has published reports of altogether nine cases which are of interest in this connection. In five of these the anomaly has consisted of distoclusion which he states he corrected merely by accustoming the lower jaw by means of certain gymnastic movements to occlude sufficiently far forward. In one of these cases the lower jaw was contracted; however, this contraction was expanded with a lingual arch, but no information is given as to whether the lower jaw was changed by the muscle exercises.

In one case was reported bimaxillary protrusion, which was treated with success. It is to be noted that this was the outer muscle group, levator and depressor labii, zygomaticus and orbicularis oris, which were active. No illustration of the position of the teeth is given. It is, therefore, probable—and the published material proves nothing beyond it—that the only effect of the gymnastics consisted in pressing back projecting teeth, i. e., overcoming a perhaps previously existing habit of the tongue to force them out.

In two cases crowding was reported, this evidently being bimaxillary. In both of these was produced a lateral increase, but it is worth noting that an artificial expansion was effected in the lower jaw, whence the expansion that took place in the upper jaw might be secondary. No other statement was made as to the various points of time at which the impressions were made, beyond the statement that the expansion was brought about very gradually. Nor is anything reported as to the final result. The lateral development in these last-mentioned cases is stated to be for the upper jaw as follows:

	CASE 1 (L. C., FIG. 6)	CASE 2 (FIGS. 7, 8)
	MM.	MM.
The first molars	2	4,5
2 temp. premolars	4	4,5
1 temp. premolar	6	3,5
temp. cuspids	3	—1
molar to central	3,5	1

Rogers' statistics offer no evidence as to the capacity of the muscular pressure to widen the apical base. His Fig. 6 clearly shows that the secondary expansion is a tipping, and not an expansion of the apical base. On the other hand his successfully treated cases, his correction of distoclusion, confirm the opinion previously submitted here that distoclusions may be faulty functions, that is to say, local-dental momenta of malocclusion. And it is quite natural that the result of a faulty function can be altered by that function being made normal, if the patient can summon up sufficient perseverance for it.

3. THE TENDENCY IN PHYLOGENETIC EVOLUTION OF THE JAW REGION WITH REFERENCE TO THE MESIODISTAL SPACE FOR THE TEETH

Experiments have shown that an organ's phylogenetic degeneration, due to reduced function, can proceed with extraordinary slowness when no attempt is made by artificial selection of the specially modified individuals to raise a spe-

cial variety. According to Semon,[73] Payne bred Drosophila ampelophora in darkness, but not even after forty-nine generations could he prove any morphological dissimilarity, although the phototactic qualities markedly declined as early as after the tenth generation. Under such circumstances it would be rash to declare a reduction in the masticatory function as the cause of such exceptionally easily observable and considerable modifications as the anomalies of the positions of the teeth.

It seems probable, however, that a superficial interpretation of palaeontological evidence as to the phylogenetic development of the denture has contributed towards establishing the idea that crowded dentures are in some way connected with a general decline in masticatory power in man. The well-known fact that diminished use of an organ can lead to its being atrophied and that this atrophy becomes hereditary has been taken to account for the existence of malocclusions. Like other weakly functioning organs, then, the jaws should also be reducible, and the crowded dentures regarded as a first manifestation thereof. (See Kemple.[41])

An apparent support for this theory was found in H. Virchow's examinations of the dental apparatus in existing civilized and prehistoric races. These investigations gave evidence on the one hand of a reduction of the entire arch and on the other of a diminishing degree of prognathism. It is true that hereby no argument could be directly adduced as to the causes of the contracted dentures as a continuation in the same direction. But by explaining the matter thus, that the jaws and the teeth have not been diminished in size to the same extent, and that atrophy of the jaws has proceeded further than that of the teeth (Pfaff[62]), it seemed as if an explanation has been found. Franke[25] assumed that this circumstance was due to the fact that only the jaws were subject to functional adaptation, the teeth on the other hand being incapable of reacting thereto as far as an alteration in size is concerned.

It is not necessary to here go into the arguments advanced by Adloff[2] to show the possibility of the teeth also being affected in their forms by functional stimulus. For whether the change is rendered possible through functional adaptation or by selection, the fact nevertheless remains that retrograde or progressive developments of the dental apparatus are known. It is sufficient to examine whether these developments support the assumption that a diminution in the use of the teeth phylogenetically offers any support to such a hypothesis as that the atrophies of the jaws proceed more rapidly than those of the teeth.

It is known that there are a number of types of mammals in which it is considered an established fact that their masticatory apparatus shows signs of a retrograde development. Among these may be mentioned in this connection Pteropus, Bradypus and Proteles. Pteropus certainly has well-developed teeth, but these lack a characteristic which is considered—at least by dental practitioners—to be necessarily associated with a strong masticatory power, namely, approximal contact.[38] This unexpected condition in a fruit-eating animal might be imagined to have some connection with the statements that the animal in question has to a large extent taken to living on fruit juices. As regard Bradypus and Proteles, it has been proved that the masticatory apparatus is gradu-

ally in a state of decline. Although as regards these it should be the case that the teeth, in the course of formation, lack the trophic stimulus of a specific function, in this case manifested as atrophy of inactivity—a thing which, on the other hand, the jaws cannot be said to lack—nevertheless the mesio-dental diameters of the teeth have been reduced in a higher degree than the length of the jaws, resulting in—not insufficient space, but excess of space for the teeth.

Now should, as Franke believes, a stronger function so affect the upper and lower jaws that the arch of the former increases in breadth and that of the latter in length, we should in phylogenetic evolution find this confirmed in so far as that where we are able owing to other circumstances to infer a more intensive function, the breadth of the upper arch and the length of the lower jaw should increase. We find, however, examples of the contrary condition. Thus, according to Abel[1] the phylogenetically more ancient genera of elephants have a longer lower jaw than the more recent, and from illustrations published by the same author (l. c., Fig. 157) it may be seen that the development Palaeomastodon—Stegodon—Elephas was accompanied by a remarkable reduction in the breadth of the dental apparatus in relation to the otherwise powerful development of the jaw. In the sagittal direction also the jaw has become so shortened in Elephas that only one or at the most two molars in each half of the jaw can function simultaneously.

We find in the large number of mammals in which different parts of the dental apparatus have been adapted to a different function, that the sections of the denture that are subject to a diminshed stress are often characterized by a larger mesiodistal space than is required for the teeth. This is the case in many of the Carnivora. A further reduction of function results in a long space entirely without teeth. Since the space *per se* can scarcely have any primary function, the length of the jaw must be in causal connection with something other than the biting function. In those forms in which the length has phylogenetically decreased simultaneously with the reduction in the number of teeth, as with Felis, there is obviously no reason for the length being maintained. It would, therefore, seem as if a diminishing functional activity in the entire dental apparatus or in some section thereof, instead of first finding expression in an atrophy of the jaws, on the contrary expresses itself at any rate simultaneously if not beforehand in a reduction in the size of the teeth, or else in the number, or both. Afterwards the length of the jaw is reduced to a corresponding extent, or is not, according to other conditions. Examples of how the length and breadth of the upper jaw can be determined by other factors than the masticatory function itself are to be found comparing the two apparently closely related animals, Hyaena and Proteles, in which the similarity of their dimensions does not seem to stand in any accountable relation to the dissimilarity between the teeth of the two genera (see Figs. 110 to 115). The function of the lower jaw is more confined to the activity of the teeth, but in conformity with Darwin's law of "correlative variation" harmonizes with the upper jaw. Thus it happens that the completely toothless Myrmecophaga has very long jaws. According to Davenport[21] anomalies in denture are from a functional point of view inferior to normal occlusion. Angle has given them the name "malocclusions."

We are perhaps justified in counting them as pathological deviations. If through altered conditions of living a type of animal has its need for masticatory power reduced, this reduction does not, so far as we know, go through any pathological intermediate stage. We would rather expect that it would change to lesser effectivity through gradual variations in the course of intermediary stages that are otherwise fully capable of function, exactly as the less used teeth in many beasts of prey have been gradually reduced until they have completely disappeared. If, then, man, thanks to a diminished use of teeth, were passing into a stage characterized by a less effective masticatory apparatus, it is to be expected that this is to take place through a reduction of jaws and teeth proceeding simultaneously and in harmony, and that it is largely the normal individuals through whom development proceeds, so long as the anomalies are not protected by artificial selection, similar to what, according to Darwin, has successfully taken place in the case of the niata-cattle.

It is well known that a number of prehistoric and modern races of savages are characterized by very effective dental apparatus with a prognathic position. Thanks to this their dentures give the impression of being more efficient than those existing in orthognathic races. Likewise their jaws give the impression of allowing more space for the teeth situated farthest back. It has been assumed, for example, that the lower jaw of Homo heidelbergensis has belonged to an individual having far more powerful masticatory organs than those of the cultured races of the present day. On the other hand there is no reason for supposing that prognathism *per se* indicates a stronger biting power than orthognathism. If the development of a more slenderly built denture is accompanied by a more orthognathous position, the apparatus becomes more effective, thanks to the more advantageous position of the muscle attachments in relation to the point of application. This is in agreement with Roux' idea that "this specific function either is accomplished with a minimum of structure and energy, or else, at any rate as far as passively functioning organs, such as bone, are concerned, * * * the reverse happens—the material employed provides the maximum of function[70] (dass diese bestimmte Funktion entweder mit dem Minimum an Struktur- und Betriebsmaterial geleistet wird, oder dass wenigstens, nämlich bei den passiv fungierenden Organen, z. B. den Knochen, welche mit mehrfacher Sicherheit gebaut sind, umgekehrt das aufgewendete Material das Maximum an Funktion leistet. Handwörterbuch der Naturwissenschaften Bd. III p. 626).

On the other hand, the prognathic denture is more useful as an independent weapon, just as the more prognathic teeth in the Canidae are more effective as independent prehensile organs than the less prognathic in the Felidae, in which the claws are used as aids. In the case of the latter family, however, the power of the jaws is considerable (Scott[72]). Again, the elephants, whose molars have been developed to a high degree of effectivity as masticatory organs, belong to the most orthognathous of living mammals. Orthognathism as such cannot be regarded as a sign of retrograde development of the dental apparatus. It merely indicates that another position of the entire masticatory apparatus in relation to the skull is more advantageous. Assuming that in modern orthognathic types the third molar of the lower jaw is more liable to cause disturb-

ances during eruption and is more often of a retrograde type or even entirely wanting than is commonly the case with more prognathic types, and assuming that in man the denture is in process of a retrograde development (Leche[45]), and that this retrograde development is due to the arrested development in the length of the lower jaw caused by a less intensive use of the teeth, we would expect that in those cases where such a considerable divergence from the normal as a lack of space for the molar exists, this less intensive use of the teeth would involve other deficiencies in the development of the apical base. Although the latter deficiencies may appear simultaneously, it is nevertheless a well-known fact that even in the most ideally formed jaws the space for the third molar can be so inadequate that its eruption may be accompanied by serious complications. In those cases, therefore, where the length of the jaw is insufficient to allow of a normal position for the third molar, the advantageous variation is when that tooth is of less than normal size or else wholly wanting.

A retrograde development of the denture in man due to lack of use, which finds expression in the reduction or disappearance of the third molar, is in full conformity with the reduction in size of the first molar in Felidae. On the other hand, no example has yet been produced of animal types with diminishing dental apparatus going through a stage of disturbance in the denture comparable to those which are characterized by arrested development of the apical base similar to those that cause malocclusions in man. In view of the extreme slowness with which phylogenetic alterations take place, it must be considered out of the question that malocclusions of the teeth, which often produce considerable divergences, are to be regarded as an introduction to or a step in the direction of a normally, i. e., nonpathologically proceeding transformation of man's dental apparatus.

4. THE EFFECT OF FUNCTIONAL ADAPTATION ON THE FORM OF THE MASTICATING APPARATUS IN MAN

From the foregoing it will be seen that the dental apparatus in man may develop under fully normal apical base conditions in cases where the masticatory activity has in all probability been subnormal; it may develop under abnormal apical base conditions in cases where the abrasion shows that an efficient masticatory activity has been going on; the apical base may be normal in the one jaw and abnormal in the other; it may be abnormally large in the one and abnormally small in the other. These facts prove that in those cases, in which no teeth are missing, the normal development of the apical base cannot be connected with the intensity of the masticatory function.

If we had the opportunity of following the evolution of an animal form which showed a progressive development from a lesser to a more effective masticating apparatus, and it became evident that simultaneously with sure signs of this progressiveness the width of the arch also increased, we would not be justified in drawing the conclusion merely from this that a broad arch was more efficient than a narrow one. For it might be that the lateral increase proved to be an advantage for other reasons and accordingly became capable of survival. Nor, if a progressive development of the masticating apparatus is accompanied

by a relative reduction in the breadth of the arch, does it denote that the reduction as such is advantageous in respect of masticatory effectiveness. But what the latter example clearly demonstrates is that this progressive development does not necessarily require a broad arch.

A study of the phylogenetic development of the dental apparatus also makes it clear that a progressive masticating activity which is expressed in an increase in the size and efficiency of the teeth is not of necessity accompanied by a relatively increased lateral width in the dental arch, and shows besides that from this department of study may be demonstrated facts which do not appear consistent with the view, advanced by Pfaff[62] and Franke,[25] that a declining function is succeeded by a more rapid atrophy in the lateral and longitudinal dimensions of the tooth-carrying parts of the jaws than in the size of the teeth.

Functional adaptation, which has so clearly been proved to affect muscles and bones, however, should be presumed also to affect the development of the shape of the masticating apparatus, even though it must be apparent from what has been previously stated that its influence is not of a nature to alter the apical base. If there are two masticating apparatuses that are identically alike, the only dissimilarity between their conditions being that the function of the one is intensive and the other's weak, there will appear traces of this different stress. An organ which in the course of development is influenced by its function does not, according to Roux' "morphological law for functional adaptation,"[68] increase uniformly, but the increase takes place only in such dimensions as supply this increase. And a corresponding reduction occurs in the case of a diminished function. In order, therefore, to prove the effect of function upon the apical base, it becomes a question of examining in what respects those jaws that have been subject to an intensive function differ from those in which the function has been less intensive.

A race of which it is known that it has been compelled to utilize its teeth and jaws in a presumably higher degree than the majority of other existing races is, according to Baker,[9] the Esquimaux. This intensive function has also, according to the same authority, left clear traces in the form of a considerable facial breadth and a broad and massive mandible. (See his Fig. 4.) On the other hand, it is not clear from his statements, nor indeed from Talbot's[78] measurements, that a corresponding increase in the breadth of the arch itself has taken place. Talbot has measured the dental arches of sixty-nine Esquimaux skulls, and found that the average breadth, measured between the buccal surfaces of the upper first molars, was 65.07 mm., or the same average as was found in the case of fifty-six Indians from the North American coast, 132 Australians and twenty-four Malayans. This breadth was exceeded by the average of 68.26 mm. in New Zealanders, Ashantis and Fijians (197 specimens), and by 66.67 mm. in South American Indians and Kaffirs (sixty-eight specimens). It is likewise known that the degree of prognathism in the Esquimaux is exceeded by that often characterizing West Africans. No support, therefore, can be derived from these figures that the intensive function affects the size of the apical base. We find that, in conformity with Roux' law just mentioned, the development has not been uniform, but has taken place in certain dimensions, and that the

apical base itself has remained unaffected as regards its size. Were this not so, then in those numerous cases in which through the absence of abrasion or through early and extensive caries of the teeth a considerably subnormal activity of the masticatory function can be proved, a normal apical base would never be developed.

The masticatory function thus has its share in the development of the maxillary apparatus, but it expresses itself otherwise than by contributing to the formation of a normal apical base. The attainment of normal occlusion involves the attainment of a normal apical base. Since, as has been pointed out in the foregoing, the latter is not affected by the masticatory function, its normal size must be due to other factors, and its abnormal size must depend upon something other than atrophy of inactivity. If this is realized, then the conclusion drawn will be that the therapy that is based on an orthodontic expansion of the narrow arch must become ineffective, and if after such treatment a permanent result is obtained this must be due to the fact that other than purely masticatory-functional factors were active simultaneously. The success of the orthodontic treatment becomes thus inseparably connected with these other factors. This means that malocclusions as regards therapy are not to be regarded merely as problems of occlusion but also as problems of the apical base.

5. APPOSITION OF BONE IN THE REGION AROUND THE APICES OF THE TEETH AS THE RESULT OF ORTHODONTIC ALTERATION OF POSITION

From Cryer's[20] illustrations of sections of the head it may be gathered that in man there is a quantity of muscle tissue situated close to the buccal surfaces of the molars. Any considerable moving of these teeth in a buccal direction, therefore, causes a displacement of muscle tissue. It is a well-recognized fact that teeth in buccal malposition are easily brought into position by the pressure of the buccal muscles, provided the space for the tooth in question is sufficiently large and that the occlusion offers no obstacle. A mere expansion of the arch itself, will, as Wallace[82] has already pointed out, be followed by a relapse to its original position due to this buccal pressure. In order to prevent this, then, the orthodontic correction must include also the moving of the whole region surrounding the apical base, so that also the muscles situated buccally have the boundary limiting their influence on the dental arch moved the same distance as the teeth. Two possible means of attaining such a result seem to have occurred to orthodontic authorities, the one by opening the sutura palatina mediana, and the other permanent formation by a reconstruction of tissue round the roots of those that have been moved and in the extensions of their roots.

The ingeniously devised attempts at expanding the entire apical base by means of orthodontic appliances must be considered to a great extent to have been failures. Even if operators seem to have succeeded to have in some degree opened the sutura palatina mediana, there are yet no data to show that an actual parallel expansion has taken place, nor that the expansion was mantained. Not even in the case of Dewey's experiments on dogs were the results permanent. In those cases in which the result was maintained, this must be ascribed to special developmental conditions if the apical base, as in Figs. 57 to 61. The

method of Barnes[12] was based on anchoring all the teeth of either half of the jaw into one entity, whereby it was intended to provide resistance sufficiently strong wherewith to open the suture. This method does not seem to have had many supporters, a fact to which the exacting technic must also have contributed. Those operators who believe the apical expansion to be necessary generally employ such methods as affect each tooth individually. The attempts at causing formation of new bone in the suture having been abandoned, the development of new bone must be considered as being confined to the immediate surroundings of the teeth that have been moved.

As has been mentioned before, Angle discovered that the abnormal inclination of the teeth that was often the immediate result of the expansion of narrow arches, could be corrected without any special orthodontic process. He ascribed this to an influence of the function which stimulated the apical development. But when he afterwards found that this natural compensating development sometimes failed to take place, he passed on to the moving of roots, being convinced that by immediately placing the teeth also in the normal inclination a compensating development would be more promptly attained. In this, therefore, he followed Case, who had long been working on the same principles. In my opinion, however, Case has not produced any proofs as to the correctness of his view. In fact, he confines himself to saying that as a result of these operations he has reason to expect[17] a filling out of the bone round the apices of the roots. As the above-mentioned spontaneous development of the apical base must be eliminated, and as Sandstedt's[71] and Oppenheim's[58] investigations offer no support to the idea of a new formation of bone beyond the apices of the roots as a consequence of the activity of the regulating appliance itself, it is hard to conceive of any other active local factor in such a new formation than the masticating function. This idea indeed seems to be a common one, to judge from current literature. However, according to statements made by authorities who have used appliances for moving the roots, and according to the descriptions which accompany the illustrations, such formation of bone does not immediately occur in direct connection with the change in the position of the root (see Case[17]). There remains, then, as a final possibility, that the masticatory function stimulates a reconstruction of bone in the root extension.

Oppenheim[59] states as a result of the extraction of cuspids erupted labially: "die Verkümmerung der Eckzahnalveole hat die Abflachung des vom Jugum alveolare dieses Zahnes nach aufwärts ziehenden Strebepfeilers zur Folge; die dadurch bedingte Ausschaltung der Übertragung des Mastikationsdruckes auf den Stirnfortsatz usw. kann nicht ohne dauernden schädigenden Einfluss auf die Entwicklung der entsphechenden Partie des Gesichtsschädels bleiben. * * * Diese Schädigungen sind durch keine orthodontischen Massnahmen mehr wett zu machen und eine volle Konturierung des Gesichtes ist ausgeschlossen."

From these expressions of opinion it will perhaps be clear that if the cuspids that are situated labially, and are consequently out of function, are by orthodontic means placed in normal occlusion, the pressure of mastication is supposed to be transmitted to the processus frontalis, and the development of the corresponding part of the facial skeleton, which would be permanently

arrested by the cuspids being extracted, would take place by virtue of the transferred masticatory pressure. Oppenheim finds support for this idea in an article by Görke,[29] who states that the closing of the jaws causes a pressure which is transmitted in an upward direction. This pressure produces reinforcements of pressure along the margin of the nose above the processus frontalis of the upper jaw, and ends above the sutura nasofrontalis. Görke calls these reinforcements "trajectories of the front teeth," and says they are the cause of crista canina.

Now it is certainly a common thing to find bony tissue in the extensions of the roots of the teeth, but it is easy to find instances, in which the supporting structure of strongly functioning teeth can have a position in relation to the roots which implies that the resistance to the stress of mastication does not at all require bony tissue of any considerable strength in a position beyond the apices of the roots. Cynocephalus has previously been mentioned as an example of this, in which animal the position of the upper molars is such that there occurs practically no continuation of the alveolar process in the extension of the roots. Above these apices the bone is extremely thin, so that elevations are visible indicating the positions of the apices, and this holds good also for the palatal roots. As the normal bony support for these well-functioning, powerful teeth is not situated beyond the apices, but along the sides of the roots, mostly in a palatinal direction, it is incorrect to assume that the stress of mastication must produce a bony reinforcement beyond the apices.

The idea that a masticatory pressure acting in a direction towards the apex is in any way more advantageous than a more right-angular pressure is not uncommon among dental authorities. Thus Angle considers that when inserting bridges the inclination of the piers must first be corrected in cases, in which they have tipped. And Strang[76] states with regard to apical expansion that by this treatment the tooth comes into what he calls a strategically more advantageous position. Presumably these two authorities suppose that a tooth having its longitudinal axis in such a direction, that the stress of mastication is more in the direction of the root axis than at right angles thereto, is less subject to pathological processes in the paradentium or can tolerate greater stress. Such opinions may be imagined to have arisen out of a mechanical view of the problem, and have been derived from such a phenomenon as that a post driven into the ground is all the more easily dislocated by a force acting from the side than from the same force acting in the longitudinal direction of the post.

From the investigations of Weski[88] it is clear that the fibres of the peridental membrane are in a direction suitable to oppose the stress upon the tooth, while in the case of unerupted teeth they have no definite direction, as in the latter case these fibres lie partly irregularly and partly parallel to the longitudinal axis. After the tooth has erupted into occlusion their directions become very characterisitc, and from the dissimilarity in different sections of the root conclusions may be drawn also regarding the direction of the stress in the region of the apex. According to Weski their direction in this region indicates that their function is to keep the tooth in the alveolus, i. e., they offer opposition to

its elongation, which would imply that they have to counteract the weakest stress to which the teeth in their natural state are subject.

If we compare the different relation which the direction of stress has to the root axes of the upper incisors in an orthognathic human type and in Simia-satyrus, and the different position of the bony base in relation to the upper molars of man and of Cynocephalus, we find that the functional adaptation taken in a phylogenetic sense may produce very different details. We cannot, therefore, determine merely from the direction of the root the direction of the stress of mastication, nor from the direction of the latter foretell in what part of the immediate neighborhood of the tooth any apposition of bone of functional origin that may eventually occur is likely to take place, still less prove that such an apposition of bone will take place in the extension of a root the apex of which has been moved buccally or labially by orthodontic means.

(*To be continued.*)

RATIONAL METHOD OF TRIMMING MODELS FROM A DIAGNOSTIC STANDPOINT*

By Sylvan Dreyfus, Lausanne

VAN LOON and Simon have already constructed their models in a way to accurately represent the position of the teeth and maxillae in relationship to the entire face. Van Loon has contributed a very complicated method which cannot possibly be used in practice. He is the one who should receive the honor of conceiving the idea first.

Simon has constructed an apparatus that simplifies this method; but this apparatus is not sufficiently practical and does not furnish the desirable scientific security. There are others, especially those of Schwarz and Bale, which are based on the principles of Professor Gyzi's articulator.

The apparatus that we describe here is but a perfected derivative fundamentally. This apparatus is composed as follows:

(1) A metal arch which is similar to the facial arch that Professor Gyzi uses. In the center, anteriorly, two parallel tubes receive the impression tray, and are fortified by two parallel bars which are likewise parallel, and which slide into these tubes. At each free end of the arch, in the center, anteriorly and 3½ cm. to either side of the center, there are five tubes in which the bars slide in a vertical direction. These bars, which are round, can likewise pivot on their axis. At the end of the bars there are slide blocks which are slightly inclined and in which bars slide also. These last bars, whose extremities are dull points, will determine the marking points which we are looking for. Having given a perpendicular movement to the first bar A, and its rotatory motion on itself, the extremity R, of the second bar B, will be able to determine any point in space. The five points that we wish to determine are:

*Reprinted from Société Française d. Orthopedie Dento-Faciale, translated by Dr. Margaret Gortikov.

1. The two superior auricular points.
2. The two suborbital points.
3. The nasion.

(b) The accessories are:

An impression tray, a large planing plate, a small ruler squared at the base and perpendicular to the edges, and to the apparatus for constructing the base of the lower model parallel to the base of the upper model, are used.

METHOD OF USE

Place the plaster in the impression tray. Place this in the mouth. When the plaster is hard, we adapt the apparatus to the impression tray by introducing the parallel bars of one into the corresponding tubes of the other.

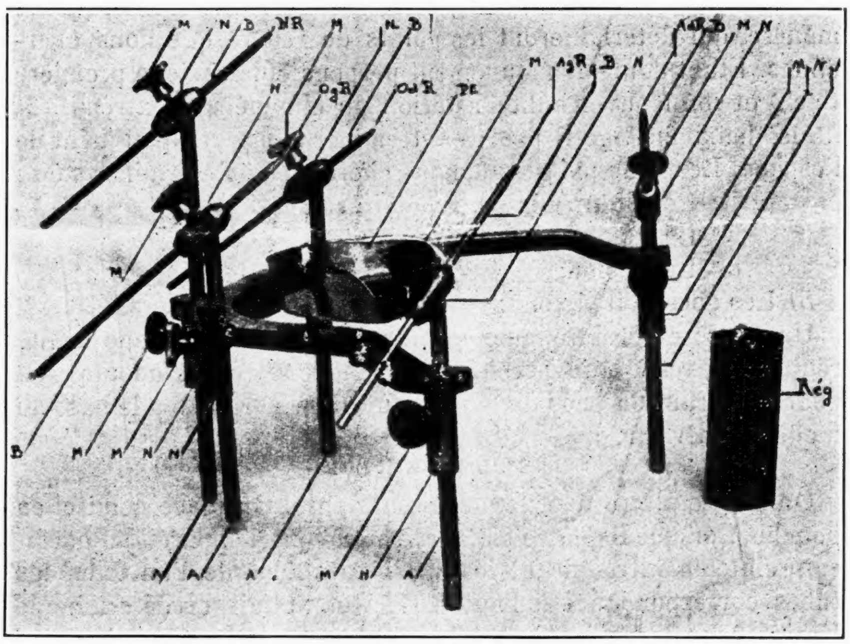


Fig. 1.—*A.* Movable vertical rod. *B.* Movable rods. *M.* Set screw. *N.* Slide block. *R.* Point-marks. *Ad-Ag.* Marks of auricular points. *NR.* Mark of the nasion. *OD-OG.* Marks of the orbital points. *PE.* Impression tray adapted to the apparatus. *REG.* Graduated ruler.

This being done we determine the nasion (n) and the orbital points (Od) and (Og), and the auricular points (Ad and Ag) by means of bars and affix these last by tightening the screws. We then withdraw the apparatus and lift out the impression tray and plaster. This completes the operative work.

In the laboratory, we reconstruct the impression, adjust the impression tray on the apparatus and pour the model. The base of the model will be determined by a flat plate which we rest on the four auricular and orbital points (if need be, we will lower the right orbital point).

The base of the model will now be the plane of Francfort itself. What is interesting and characteristic of our apparatus is the fact that the anatomic points that have served as marking points are found on this plane. The nasion being outside this plane, we project it vertically upon this one by

means of a small ruler, and we note how many mm. distant it is from the plane; let N′ be this point. We trace AO and ON on this base and these lines join the auricular point to the orbital point at the projection of the nasion.

We write on the model:

1. The distance from the plane to the nasion.
2. The distance between the orbital and auricular points in such a manner that we can always determine these last.

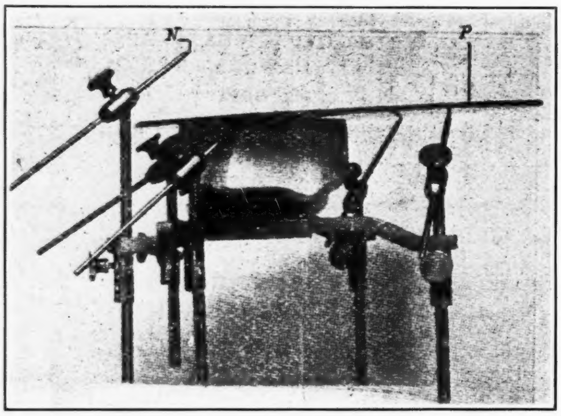


Fig. 2.—*N.* Nasion. *P.* Plate of apparatus whose inferior surface constitutes the plane of Francfort.

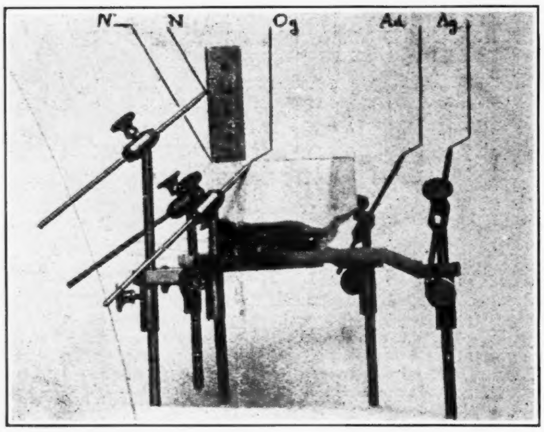


Fig. 3.—Projection of the nasion on the model. *Ad-Ag.* Auricular points. *Og.* Left auricular point. *N.* Nasion (28 mm. about the Francfort plane). *N′.* Projection of the nasion on the plane of Francfort (superior surface of the model).

Finally we use an apparatus which will allow us to trim the surface of the model perpendicular to the base.

After the bases of both upper and lower models are parallel to each other we articulate the two models in a way similar to the patient's occlusion, flow some plaster on the lower model and place them between the two parallel plane plates. On the superior surface of these plates each one has two tubes that are parallel to each other and perpendicular to the plate. These tubes slide into one another. Now the models have parallel bases and their height is regular, facts which are advantageous for the series of the collection.

The fact that the surfaces of the model are perpendicular to the base, the edges which they determine are likewise parallel to this base and so to the plane of Francfort. The two edges passing through the points O are now in Simon's plane and the relationship of these last to the teeth can be seen directly. The edge passing through point N is in the nasofrontal plane and we see, consequently, the relationship of this last to the incisal region. To use an imaginative expression, we might say the prognathus or retrognathus appears before our eyes.

The advantage of this method is that it gives a precise, easy, scientific and direct diagnosis. The less experienced person on seeing a similar model will say: "To be sure, there is such a thing to correct."

Then again, this method is precise from the point of view of teaching, because it allows us to show the students the different models of a case evolving from the first to the last, not only from the occlusal standpoint, but also in relationship to the face in general, especially to those anthropologic planes and points which we use. Not only does this method allow for a definite diagnosis, but it also simplifies instruction by the presentation of models made according to the former.

DISCUSSION

M. G. Izard.—M. Dreyfus has already happily completed Simon's method of examination by establishing the diagnoscope. Today he presents us with a very interesting way of trimming models, allowing us to have the principal facial points, in addition the superior surface of the upper model is placed at the level of the plane of Francfort. We crave in this a precious element for diagnosis as the arches are correctly situated in space.

The only inconvenience in this method is the great bulk of the models. Then again we might reserve their construction for special cases necessitating a profound study. They render valuable services in the teaching of orthodontia.

M. E. Conte.—I have been very much interested in Dreyfus' presentation, his apparatus is a modification of Schwarz's, but I do not know of what value it will be.

For almost eighteen months, I have used Schwarz's apparatus, exclusively for taking impressions and for the preparation of the models; I do not find that the size of these models are exaggerated, I have more than 300 of them; they are all of uniform height and bulk. This does very well for a display case.

On the other hand, I wish to add that Schwarz has again improved his method a little; he has so modified his lower impression tray that he can attach a little cap to it for taking impressions of the chin. This is then carried on to the lower model which is then cut according to this height, and furnishes an additional element for diagnosis, since we have the gnathion as well as the nasion.

The models are not uniform in height then.

M. G. Villain.—We must use these models so as to be able to give an account of what can be obtained from it. What interests me, is the fact that these models combine a sufficient number of elements in a relatively small volume, whereas the models constructed according to Van Loon's method cover two-thirds of the head in volume.

Evidently these models are very interesting for research work, but of little practical value to the practitioner.

I congratulate Dreyfus for having shown the practitioner, the same as Schwarz has done, the possibility of making models that can be used daily, which are not cumbersome, are easy to manage and that furnish the marking points that are necessary in the course of treatment. It is necessary that we be able to make this comparison in a rational way and not use to much time.

Little by little, our material is increasing and the time will come when we will acquire the precise foundations on which we will be able to work. When we bring in comparisons, the work will become easy for us. We must come to the point where we can make our methods uniform.

M. G. Izard.—It has been decided that an important (large) sum be devoted toward the purchases for work. I believe it will be necessary to reserve a part of it which is destined for procuring apparatus for examination purposes, used in France and elsewhere. In fact, it is indispensable that the Society possess all of the means of examining and studying, that are useful for orthodontia.

M. J. T. Quintero.—I propose we submit this question to a committee so as not to interfere with the meeting.

M. S. Dreyfus.—I haven't much to say. They have spoken about teaching in schools and the difficulties of being able to have the students follow the treatment to the very end. With ordinary models the students do not see the relationship of the maxillae with the different points of the face, while with this method we can see it. You can tell them: ''This is what we had before and this is what we have now.'' Not only does this method allow us to make a positive diagnosis, but it facilitates teaching by the presentation of models made by those who were prior to those studying now. We can make a model at the start and in the middle of treatment always have the same points of comparison. Then again, my method not only permits a surveying of the models, but also to carry the anatomic points on them and trimming them in a rational manner. I underline:—my models are not only surveyed, but they represent the entire face itself.

M. J. T. Quintero.—M. Dreyfus has simplified Simon's and Schwartz's methods. We must acknowledge this and thank him for having presented us with this practical realization. The interesting part of his method to my mind, is to be able at any moment to estimate in an absolutely mathematical fashion the changes that are produced in the jaws since the beginning of treatment.

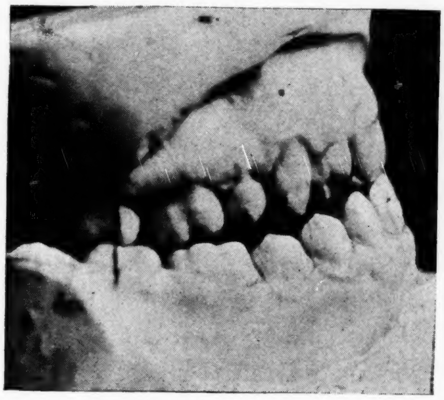
This morning, I have just received the December number of the INTERNATIONAL JOURNAL OF ORTHODONTIA, and I find on p. 761, a figure representing an apparatus that allows measurements to be made to within 1/10 mm, and situated correctly in space. As it is the apparatus appears to me to be very useless, it has no fixed base and the base is one that is usually given to a model that is trimmed any which way.

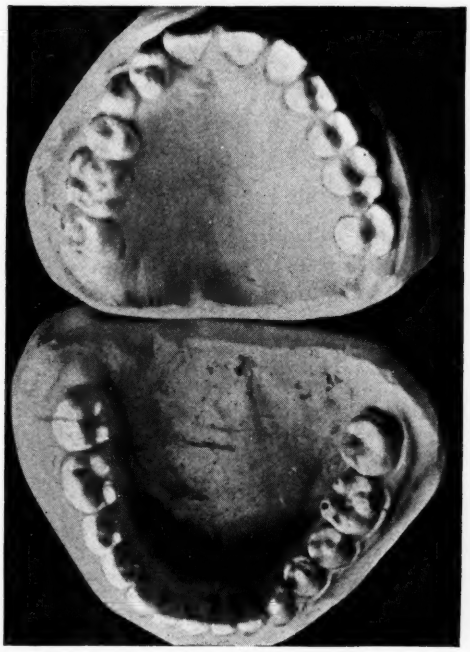
On the contrary, when using the apparatus according to the method described by Dreyfus you have exactly to the 1/10 mm. the initial position of each tooth and each portion of the palate, and by degrees, as your treatment advances, you can determine the exact position of each tooth and each part of the palate after the displacement. I think it would be interesting to combine Dreyfus' apparatus with this apparatus which was exhibited at London last year. Those who, like me, were there, know the inconvenience that it presents, but they could also appreciate the considerable amount of work that its realization has required of the author, Dr. F. L. Stanton, of New York.

A CASE OF DEFICIENCY OF TEETH AND OPEN BITE*

By L. E. Claremont, L.D.S.

THE patient was a male, aged nineteen. The maxilla showed transposition of the right maxillary first premolar into the position of the right maxillary lateral incisor. The lateral incisors were absent as revealed by x-ray photographs. The articulation was far from normal, the anterior teeth being





practically edge to edge in occlusion. Grinding in the bite of the posterior teeth, and, at the same time, forcing the maxillary incisors slightly forwards by mechanical means was considered to be the only possible line of treatment to adopt, if indeed it were wise to interfere at all.

*Transactions of the British Society for the Study of Orthodontics.

FIRST INTERNATIONAL ORTHODONTIC CONGRESS

THE meeting of the Board of Governors was held at Hotel Vanderbilt on Wednesday, October 28th. Under business there was the adoption of the Constitution and By-laws, which appear herewith.

CONSTITUTIONAL BY-LAWS OF THE FIRST INTERNATIONAL ORTHODONTIC CONGRESS

Article I.—The name shall be, The First International Orthodontic Congress.

Article II.—The Congress will be held in New York City, New York, United States of America, at the Hotel Commodore, August 15th to 22nd, 1926, and will open with registration, Monday morning, August 16th, preceded by a meeting of the Board of Governors on August 15th. The general session will convene at two o'clock Monday, August 16th, and will close with a general session Friday evening, August 20th, and a meeting of the Board of Governors and Committees on Saturday, August 21st.

Article III.—The object of this Congress is the advancement and study of the science and specialty of orthodontia.

ORGANIZATION

Article IV.—The following societies having voted to become a component part shall constitute the membership societies of this Congress: American Society of Orthodontists, New York Society of Orthodontists, Rocky Mountain Society of Orthodontists, Southern Society of Orthodontists, Southwestern Society of Orthodontists, Eastern Association of Graduates of the Angle School of Orthodontia, Alumni Society of the International School of Orthodontia, Alumni Society of the Dewey School of Orthodontia, European Orthodontological Society, British Society for the Study of Orthodontics, Societe Francaise d'Orthopedie Dento-Faciale, and the Deutsche Gesellschaft für Zahnarztliche Orthopadie, and such other societies that the Board of Governors shall decide have presented the necessary qualifications.

MEMBERSHIP

Article V.—Membership in the congress shall be in two classes:

A. Regular Membership.—This membership can be had only through membership in component societies. It carries the right to vote and hold office. A payment of ten dollars ($10.00) by a recognized orthodontic society and the endorsement of the plan of the congress makes that society a component part of the congress and its members regular members of the congress and entitles the society to a bound copy of the proceedings.

A regular member desiring a bound copy of the proceedings must pay ten dollars ($10.00) as does a subscribing member.

B. Subscribing Membership.—This membership is open to all ethical members of the dental and medical professions, irrespective of their membership

in the component societies. The dues for this membership shall be ten dollars (10.00) and shall entitle the member to all the privileges of the scientific session and a bound copy of the proceedings. He shall have no right to vote or hold office unless he is a regular member.

C. Honorary Membership.—The Board of Governors may elect honorary members of the Congress.

FUNDS

Article VI.—All moneys, both from the component societies and the subscribing members, shall be received by the treasurer-general. No bills shall be paid by him until they have been O.K.'d by both the president-general and the secretary-general. The board of governors shall appoint an auditing committee of three members who shall audit the accounts of the treasurer-general after the close of the congress. Any moneys remaining shall either be prorated by the board of governors to the various component societies in proportion to their membership in the congress or shall be held in trust by the treasurer-general or a designated bank or trust company until the second International Orthodontic Congress shall be instituted. Any deficits shall be met by the component societies in America in proportion to their respective membership in the congress.

OFFICERS

Article VII, A.—The Officers of the Society shall be a President-General, Secretary-General and a Treasurer-General elected by those in attendance at the Organization Meeting in Atlanta, Ga., U. S. A., April 15th, 1926.

B. Each component society may elect one Honorary Vice-President to the Congress and one member to the Board of Governors (duties later defined).

C. Honorary Presidents.—The Component Societies may recommend three names to the Board of Governors with recommendation that they be made Honorary Presidents. The Board of Governors will elect to Honorary Presidents of the Congress those who in their judgment have so contributed to the advancement and progress of the specialty as to warrant this honorable position.

BOARD OF GOVERNORS

Article VIII, A.—The Board of Governors shall consist of a representative of each component Society together with the President-General, Secretary-General and the Treasurer-General.

B. The board of governors shall, as its name implies, be the governing body of the congress and in all matters pertaining to the advancement and conduct of the congress their decision shall be final. For the transaction of all business, seven shall constitute a quorum, but because of the probability that the members of the Board of Governors will be scattered over great distances in both America and Europe, an absent member may nominate a proxy for a particular meeting provided there is no objection from two or more members of the board. (This provision is merely inserted to expedite the transaction of business by the board of governors and to give its decisions a legal as well as an ethical standing.) The president-general may appoint with the consent of the board of governors such committees as will

be found necessary to the successful consummation of the congress. The president-general, secretary-general and treasurer-general shall be members of the board of governors and members ex officio of all committees.

COMMITTEES

Article IX.—Among the necessary committees will be an executive committee of five members who shall function for the board of governors and under its instruction. This executive committee will serve as an ad interim board and shall have all of the power and privileges of the board of governors, but its actions will be subject to the final approval or rejection by the board of governors itself. This committee will be found necessary to care for much detail work which it will be impossible for the board of governors to efficiently transact because of the aforementioned difficulty of obtaining frequent meetings.

There shall also be a program committee of five appointed by the president, three of whom shall be members of the Board of Censors of the American Society of Orthodontists. This committee shall have full charge of papers and clinics. The reasons for arbitrarily placing on the program committee three members of the Board of Censors of the American Society of Orthodontists are: that this committee always functions as a program and clinic committee for the American Society of Orthodontists; it is a progressing committee serving from year to year throughout a three-year term and necessarily is familiar with that character of work.

SCIENTIFIC SESSIONS

Article X.—Rules and regulations covering the presentation of papers, clinics and case reports:

A. All papers, case reports, clinics and communications of any character whatever shall be the property of the First International Orthodontic Congress and the publication of the same, either in whole or in part, shall be determined by the Board of Governors upon the advice of the Program Committee.

B. English, French, Spanish and German shall be the official language of the Congress, but papers (case reports and clinics) in any language other than English must be in the hands of the Program Committee not later than the first of June, 1926, in order that a translation and synopsis may be made.

C. All other papers, descriptions of clinics and case reports must be in the hands of the Program Committee not later than the first of July, 1926. All papers must be typewritten, ready for printing, accompanied by illustrations.

D. A maximum of forty minutes will be allowed for the reading of a paper; ten minutes for the speaker selected to open the discussion (which discussion must be in writing); and five minutes for any member continuing the discussion. The essayist will be allowed five minutes to close the discussion.

E. Any paper that cannot be read in thirty minutes must have a synopsis of the essential points accompanying it and twenty-five minutes will be

allowed for the reading of this synopsis. The same rules in discussing the synopsis will apply as in discussing a paper.

F. Under no condition will a member who has spoken on a subject be again allowed the privilege of the floor for discussing the same subject unless it be to answer an important question the reply to which must not take over one minute.

G. The Board of Governors will endeavor as near as possible to give an opportunity to discussors to edit their own discussion. Wherever this is not possible the Board will assume the responsibility of editing the same.

H. Before speaking, members must call their name to the Presiding Officer or present it in writing to the Secretary. This is imperative, no matter how well the speaker may be known.

NOTE.—These rules regulating the time allowances in the scientific sessions WILL BE ENFORCED without favor at all times by the Presiding Officer.

NOTE.—It is the wish of the Board of Governors that all of the Honorary Presidents and Honorary Vice-Presidents do respond when called to preside at any time during the Scientific Assembly.

DEPARTMENT OF

ORAL SURGERY, ORAL PATHOLOGY AND SURGICAL ORTHODONTIA

A COMPARATIVE STUDY ON THE TOXICITY OF LOCAL ANESTHETICS

BY JOHN A. HIGGINS, CHICAGO, ILL.

CUSHNY,[1] in his text, states, "The toxicity figures given by different authors show great variation, which apparently arises from the different methods employed and very often from the speed of injection; clinical experience shows that novocaine is presented in an unfavorable light by these experimental results."

Clark[2] states that "Eggleston and Hatcher have investigated the toxicity of the local anesthetics. Previous workers obtained extremely discrepant results, but Eggleston and Hatcher showed that the toxicity of these drugs depended to a very large extent upon the manner in which they were injected, and even upon the rate at which they were injected."

Quoting from the *Mouth Mirror*,[3] we read, "The statement persistently advertised that novocaine is six or seven times less toxic than cocaine is of German origin; it started at three times, and I have seen it stated at ten times less toxic than cocaine. It is well to bear in mind that there are three sources (apart from synthetic) of cocaine: Bolivia, almost pure cocaine; Peru, about half cocaine; East India (Java), almost all truxilline, which is admittedly highly toxic.

"Java cocaine, according to Squire, is very largely used in Germany; hence we see how the comparison may have been arrived at, if it were not merely commercial push."

Since there apparently seems to be some question as to unity of results by different investigators it was considered of importance to investigate possible chances of error due to different sources of drug supply, as in the case of cocaine. Also it was considered of importance to show in a graphic or chart manner some of the results obtained by other investigators than my-

self. Cocaine being used freely as a basis of comparison for other local anesthetics, it was given first consideration in this investigation.

One of the chemical tests for the purity of a local anesthetic is the melting point. The United States Pharmacopia (9th edition) states, in regards to cocaine hydrochloride, which seems to be the salt of cocaine most universally used, "It melts between 182° C. and 191° C., the higher melting point indicating greater purity."

From personal observations I have had cocaines to contend with where the melting point went as high as 205° C. In testing out some of these different melting point cocaines for the minimum fatal dose the following results were obtained:

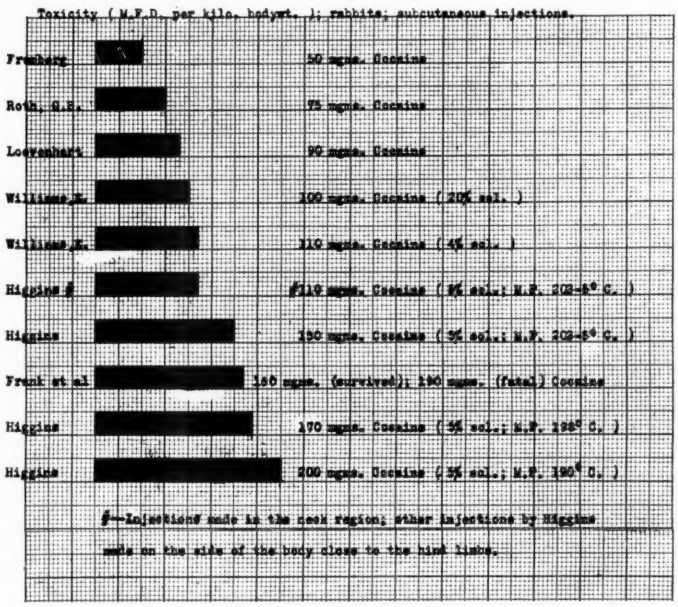


Fig. 1.

Toxicity; subcutaneous in rabbits (points of injections not altered)

Melting points	Minimum Fatal Dose
190° C.	.19 to .2 gm. per kilo bodyweight.
198° C.	.165 to .17 gm. per kilo bodyweight.
203°-205° C.	.14 to .15 gm. per kilo bodyweight.

Toxicity; intravenously in rabbits

Melting points	Minimum Fatal Dose
190° C.	.012 gm. per kilo bodyweight.
193° C.	.013 gm. per kilo bodyweight.
198° C.	.018 gm. per kilo bodyweight.

The same concentration of solutions was used in obtaining the above subcutaneous minimum fatal doses, while in regards to the intravenous injections, 1 per cent solutions were used and the injections were made at a constant rate of 1 c.c. in eighteen seconds (Figs. 1 and 2). From the previous toxicity figures it will be noted that the higher the melting point the

more toxic the cocaine is subcutaneously, while intravenously the higher the melting point the less toxic the cocaine. At this point I might add that I have found the cocaines to vary in efficiency as well as toxicity in comparison to their melting points.

Since cocaine seems to be freely used as a basis of comparison for other local anesthetics, "considering the toxicity of cocaine as 1 and expressing the experimental toxicity of substitutes of cocaine as a fraction,"[4] and from the work of Schmitz and Loevenhart[5] we will likewise note, "Cocaine was

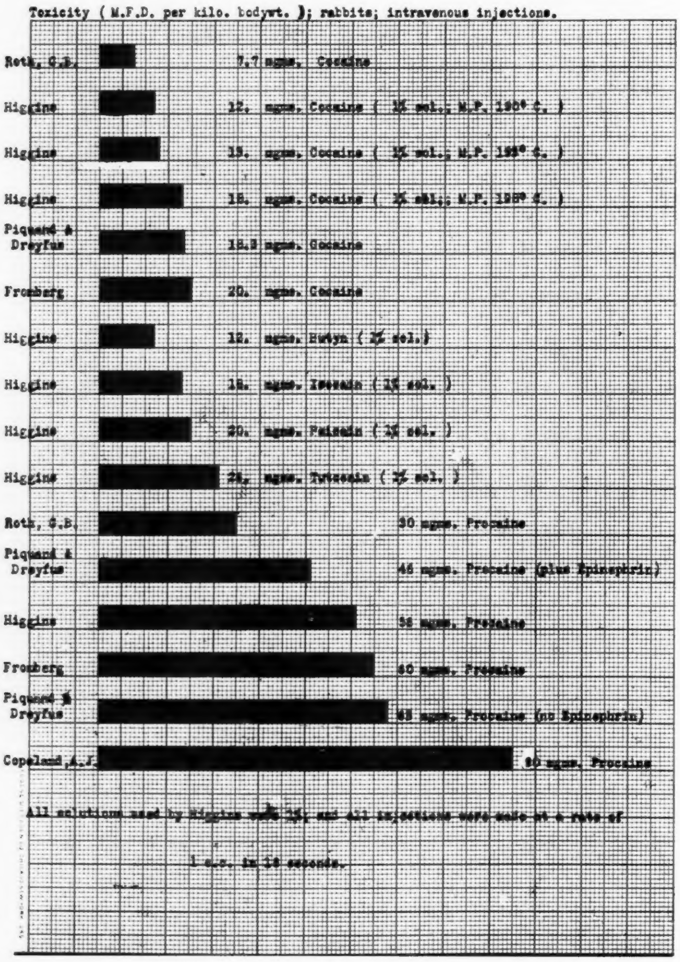


Fig. 2.

added to the list of substances investigated and was used as a basis of comparison for the other substances," would it not seem to be more logical to set a standard for cocaine hydrochloride itself before assuming cocaine as a unit (1) to compute the toxic value of other local anesthetics?

In the frog, Roth[6] found procaine to be more toxic than cocaine. In my experimental work on frogs I quite agree with Roth as far as the toxicity of novocaine is concerned, i.e., M.F.D.—0.7 gm. per kilo bodyweight, but in regards to the cocaine I felt that the absorption was so delayed that the drug did not have a fair chance to get in its proper action. Following a

period of forty-eight hours from the time of the cocaine injections and when I undertook to open up the frogs and note the position of the heart, much cocaine solution was still to be found in the saccus abdominalis, where injected. For this reason I did not attempt to draw conclusions as to the minimum fatal dose of cocaine in the frog.

In regards to the toxicity in albino rats (Fig. 3) feeding conditions seem to play an important part in results obtained. The toxicity figures on procaine, for example, could be made to vary from 1.9 grams per kilo bodyweight, in good healthy albino rats that were supplied with a general mixture of foods, to 1.4 grams per kilo bodyweight in albino rats fed on only one type of stock food. Reid Hunt[7] has already called attention to a similar point in the albino mouse, "toxic dose of drugs in the mouse may vary with its diet." Loevenhart[5] also states, "These facts suggest that the rat is in the majority of cases a poor type of animal upon which to base conclusions in regards to toxicity." The albino rat, nevertheless, seems to be a fairly

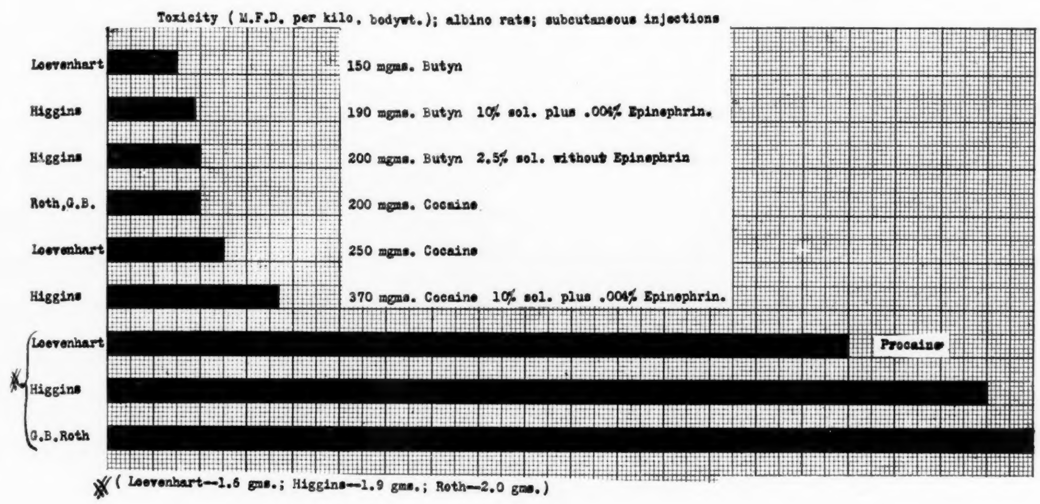


Fig. 3.

reliable animal for comparative testing provided good housing quarters are maintained and a general variety of foods are supplied to the animals.

The guinea pig was not used very extensively in carrying out toxicity tests (Fig. 4). However, the results were added for comparison with the results obtained by other investigators. Copeland's[9] minimum fatal dose in the guinea pig had been changed from a previous indefinite figure of "below 60 mg." Regarding this change Copeland states, "The figures for cocaine given in my previous paper have been modified, and represent the results of experiments made with a sample of cocaine hydrochloride having a melting point of 182° C. (normal 183° C., Martindale)" Can we hope, accordingly, to bring about a unity of experimental results from cocaines with such variable melting points or are we to ignore the melting points and purity of the cocaines and let our results lead to much confusion?

The rabbit was used very extensively in carrying out toxicity tests (Figs. 1, 2, and 5). Loevenhart[5] states that, "The rabbit likewise seems to have a very high degree of tolerance to cocaine, especially if injected subcu-

taneously. The purity of the cocaine or variation of the melting point will alter the rabbit tolerance toward cocaine." The synthetic local anesthetics, i.e., procaine, butyn, etc., with the possible exception of tutocain, injected subcutaneously in rabbits, respond rather favorably in ratio of toxicity (weight for weight) with the cat and dog.

In Fig. 1 it will be noted that the minimum fatal doses obtained by Williams[8] show a difference due to the concentration of the drug injected. In Figs. 1 and 5 it will also be noted that the minimum fatal doses of cocaine and butyn injected into the neck region are much smaller than similar injections made on the side of the rabbits close to the hind limbs. In the case of procaine the minimum fatal dose remained the same regardless of where the drug was injected. In one other instance I have noticed where the local anesthetic (G.S.—No. 525) did not show an increase in toxicity, when injected subcutaneously in the neck region of a rabbit over subcutaneous

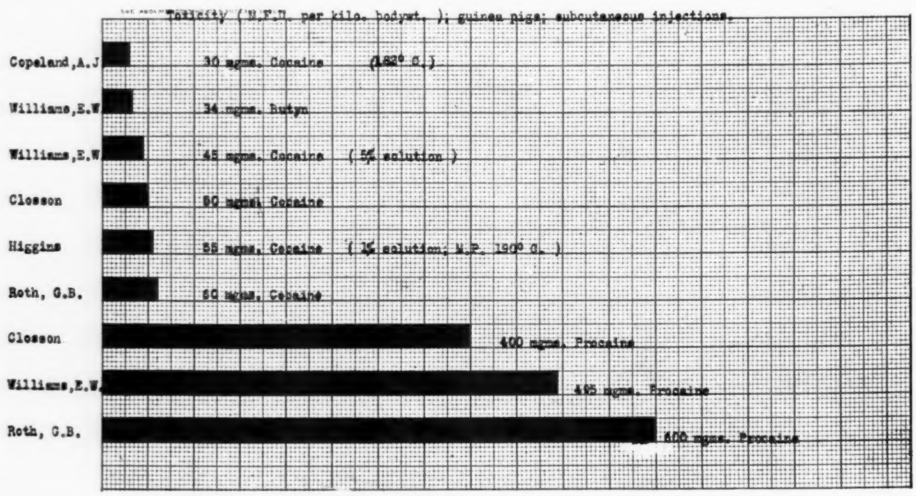


Fig. 4.

injections near the hind limbs. This increased toxicity following neck injections is undoubtedly an important factor to the dentist as well as doctors who specialize in nose and throat operations.

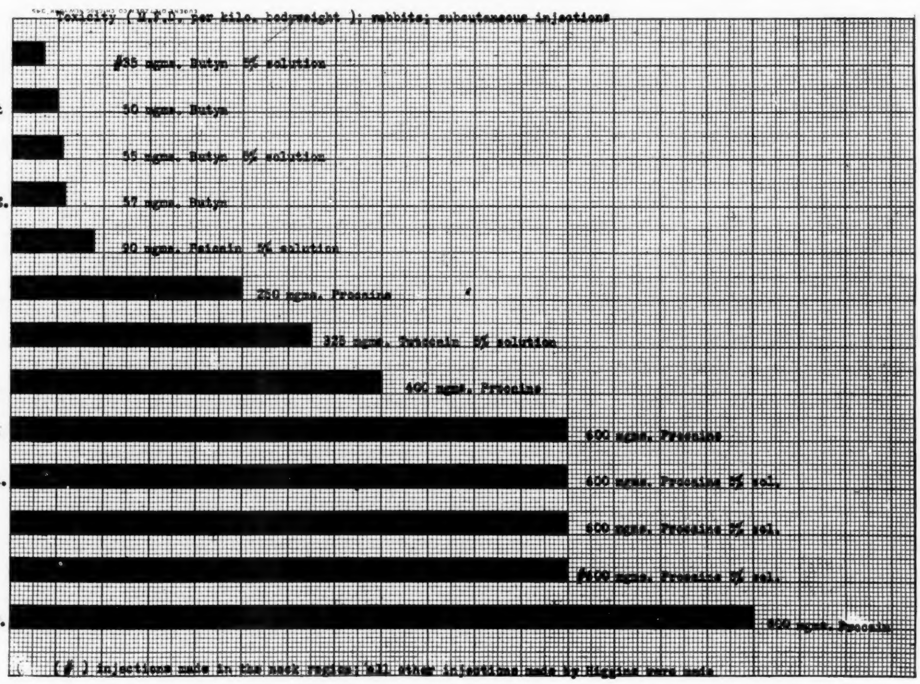
Figs. 6 and 7 show the toxicity results obtained in cats. In Fig. 6, the minimum fatal doses obtained by Loevenhart are much lower than the results obtained by Higgins. The point of injections and the concentrations of the drugs used by Loevenhart might explain the difference of our results. In clinical operations the local anesthetics are never administered orally to patients. Since local anesthetics are applied locally in nose and throat operations and since there would seem to be some danger of a patient swallowing some of the drugs, this is the explanation for carrying out drug-feeding experiments as noted in Fig. 7. These animals, as in all toxicity tests, were starved for approximately eighteen hours before using.

Fig. 8 shows the toxicity results obtained in dogs. Regarding subcutaneous injections of isocain in dogs the minimum fatal dose had not been

reached. Dogs survived 325 milligrams per kilo bodyweight. The minimum fatal dose of tutocain in dogs will fall below 200 mg. per kilo bodyweight.

GENERAL DISCUSSION

My point in view in compiling results obtained by other investigators, as well as my own results, is to give the dentist as well as the doctors in medicine a general conception on experimental toxicity results obtained in the past. In the experimental work carried out by Higgins the concentrations of the drugs injected are noted, also the rate of injections (where intravenous injections are made) are the same, i.e., 1 c.c. in eighteen seconds and with 1 per cent solutions.



(#) injections made in the neck region; all other injections made by Higgins were made in the side of the animals near the hind limbs.

Fig. 5.

It will be noted that the toxicity figures obtained by Roth are, in a number of cases, rather low as compared to results obtained by other investigators.

Where local anesthetics are injected experimentally, I would suggest reporting on the concentration of the drug employed. Where local anesthetics are injected into the circulation, I would suggest a definite rate of injection; personally, the words "rapid injections" seem rather indefinite.

Cocaine, in a number of instances, produced a delayed poisoning from subcutuaneous injections or other means of administration, for example:

Dog No. 20: weight 12.33 kg. × 40 mg. per kilo bodyweight. Injected at 2:56 P.M., June 1. Dog became greatly excited, but had no convulsions up to 5 P.M., June 2. Pupils were still dilated and dog was excited at the later time. Dog found dead on the morning of June 3.

Cat No. 5: weight 1.98 kg. × 50 mg. per kilo bodyweight. Injected at 3:15 P.M., June 22. Pupils became dilated; increase in saliva and stage of excitement were noted. Convulsions set in at 3:28 P.M. At 5 P.M. (same day) the cat apparently seemed to be recovering from the injection and the convulsions had subsided. Animal was found dead the following morning.

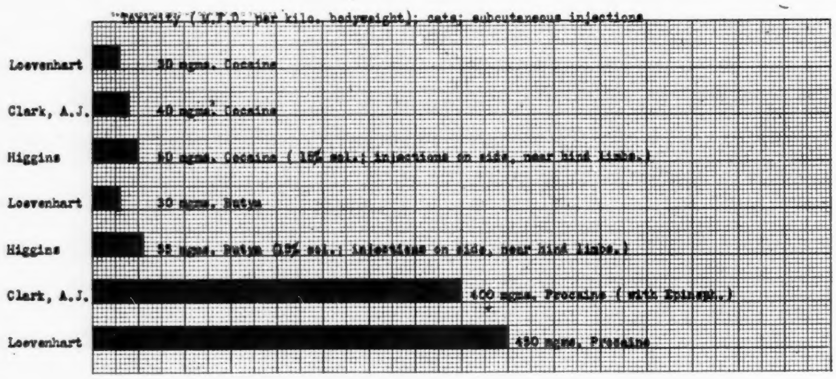


Fig. 6.

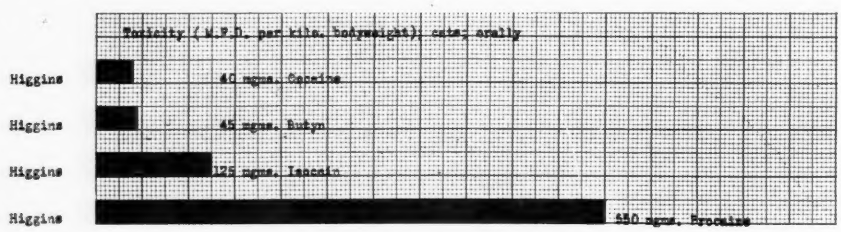


Fig. 7.

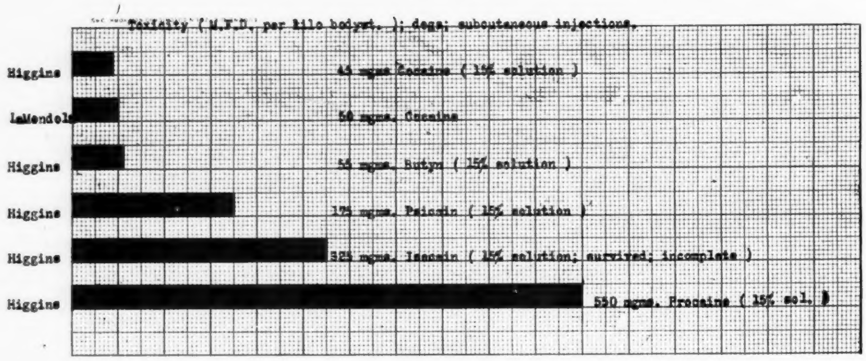


Fig. 8.

Monkey No. 5; weight 2.745 kg. × 30 mg. per kilo bodyweight. Injected at 3:01 P.M. Convulsions set in at 3:05 P.M.; 3:21 P.M. respiration was thirty-six inspirations per minute; at 3:44 P.M. convulsions had stopped, and respiration was eighty-four inspirations per minute; animal lay on right side but kept his eyes rolling from side to side as if taking notice of the surroundings; 4:05 P.M. convulsions reappeared in a milder form; animal died at 4:21 P.M.

Cat No. 10: weight 4.35 kg. × 40 mg. per kilo bodyweight. Given orally at 8:48 A.M., May 9. Increase in saliva at 10:50 A.M.; one convulsion at 1:22

P.M., no further convulsions during the rest of the afternoon. The following morning the cat was panting, convulsions set in with a fatal result at 12:14 noon.

From the above examples of delayed poisoning from cocaine I would suggest that doctors check up on their patients for at least twenty-four hours from the time of an injection of a local anesthetic and wherever it is convenient or possible to do so. In no experiments have I noticed similar delayed poisoning from the synthetic local anesthetics; still such results in clinical operations are not improbable.

There seems to be no question of doubt but what procaine (novocaine—Metz trade name) is the least toxic of the local anesthetics so far tested. Its ratio of safety over cocaine, of course, varies with the cocaine used. The ratio of toxicity between procaine and butyn is approximately 5 to 1 from intravenous injections in the rabbit and approximately 10 to 1 from subcutaneous injections in all animals so far used in this test. On the blood pressure of dogs the following few results are here tabulated for comparison:

DRUG INJECTED	RISE IN BLOOD PRESSURE	FALL IN BLOOD PRESSURE	
Procaine		23 mm. Hg.	1 c.c. of a 1 % sol.
Cocaine (190° C.)	14 mm. Hg.	48 mm. Hg.	
Butyn		40 mm. Hg.	
Butyn		25 mm. Hg.	1 c.c. of a 1 % sol.
Procaine		14 mm. Hg.	

Procaine and butyn on the dog's blood pressure give an abrupt fall and a fairly progressive return to normal. Cocaine on the blood pressure of the dogs may produce a slight rise followed by either a fall with a delayed rise to normal or it may give the preliminary rise with no appreciable fall. Here again cocaine varies as to its purity.

While procaine has been used clinically in large amounts with perfect safety for major operations,[10] yet it has been known to produce side actions from "a few minims." Now, with such a wide margin of safety between the surviving dose of procaine for animals and the amount of procaine injected into the human ("a few minims") and producing side actions, leaves doubt as to the procaines being solely at fault. Personally I would be inclined to suspect some solvent or other impurity in the procaine; the involvement of a pathologic condition; an error in technic, i.e., an intravenous injection or such; a psychologic reaction; or the epinephrin added may be at fault.

In Fig. 2 the toxicity results obtained by Higgins, Fromberg and Piquand and Dreyfus from intravenous injections of procaine in the rabbit check up rather favorably. Likewise in Fig. 5 the toxicity results obtained by Loevenhart, Copeland and Higgins from subcutaneous injections of procaine in the rabbit check up very well. Where epinephrin has been added the local anesthetics become more toxic when injected intravenously.

While the results herewith mentioned are of scientific interest and record the results obtained from experiments on animals, yet the question of human safety must not be based solely on experimental figures. However,

the large amounts of procaine that have been injected into the human for major operations, without side actions or fatal results, would tend toward favoring procaine as the least toxic even in the human. One may consider the "efficiency" of a local anesthetic as a prime factor and inject minimum amounts of a very toxic (experimentally) drug without producing side actions or fatal results. This, of course, is a matter of individual choice but nevertheless one should not permit himself to be dislodged from a defensive position.

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DEPARTMENT OF
DENTAL AND ORAL RADIOGRAPHY

Edited By
Clarence O. Simpson, M.D., D.D.S., F.A.C.D.,
and Howard R. Raper, D.D.S., F.A.C.D.

PROTECTION FROM AN X-RAY STANDPOINT*

By E. C. Jerman, Chicago

IN THIS article, protection is considered only from the standpoint of those who are working with the x-ray as a diagnostic agent, using energies up to 100 milliamperes and up to 140 kilovolts peak. This article does not apply to x-ray work as applied to so-called deep x-ray therapy. This is not intended as a scientific discussion, but, rather, as a practical consideration of the subject.

As an instructor in x-ray technic, the writer is placed in such a position that the information regarding protection must be given constantly, for the benefit of all concerned. He wishes it to be understood that he is expressing only his personal opinions, based upon an experience of some twenty-nine years in the operation of x-ray equipment, and a careful observation of what others, similarly situated, have been doing. This article has been prepared especially for the benefit of the lay assistant, the technician.

The maximum amount of x-ray radiation which any individual may receive without any ill effect would be exceedingly difficult, if not impossible, to predetermine. Some individuals may be more—or less—susceptible than others. The extreme difficulty that enters into any exact measurement of the total energy the operator or technician may be receiving from day to day adds to the complications.

Probably one of the best general rules to observe and follow is the rule of common practice. So long as the procedure in any given laboratory corresponds to that in the great majority of other laboratories, safety from both a moral and legal standpoint is pretty well assured. This rule of common practice has had much to do with the forming of the writer's conclusions.

Protection will be considered from the standpoint of, first, the operator or technician; second, the patient, and third, the visitor. Protection of the operator or technician from x-ray energy, high tension current and foul air,

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and protection of the patient and visitor from x-ray energy and high tension current will be considered.

FIRST, THE OPERATOR OR TECHNICIAN

X-Ray.—Due to the fact that the technician is operating the equipment from day to day, he is subjected to a greater continuous danger than the patient or visitor.

The tube should always be operated while within the lead glass bowl provided for that purpose and never in the open.

The technician should always occupy a position to the rear of the tube or within the inactive hemisphere with the face of the anode or target from him, or out of sight, while the tube is in operation.

The control board should be so placed, in relation to the tube, that a distance of five or six feet, as a minimum distance, will always be maintained between the technician and the tube. The greater this distance the greater the safety factor.

When using more than a five-inch gap (87 kilovolts peak) and thirty milliamperes, some kind of a protective device (a leaded glass or lead screen) should be placed between the technician and the tube while the tube is in operation. Plate glass about one-half inch thick or sheet lead about one-eighteenth inch thick are ordinarily used for this purpose. If the average number of usual exposures made daily exceeds twenty-five, if the tests (description of which follows later on in this article) indicate that the operator is in danger, or if the equipment is to be used for x-ray therapy, the control stand should be placed in an adjoining room with a double plaster wall and lead glass window between or a lead-lined booth constructed for the use of the technician. If the booth is used, it should be lined with three-sixty-fourths to one-sixteenth inch lead, top, bottom and all sides, and be provided with a lead glass window. It would now be better to increase the minimum distance between the technician and the tube to ten feet, or more, if it be convenient.

There are two methods in common use of estimating the amount of stray or secondary x-radiation that may exist in the vicinity of the operator,—the film test and the fluoroscopic test. In using the film test method a clean, fresh dental film packet is selected. Two pieces of sheet lead one-half inch square and from one-thirty-second to one-sixteenth inch thick are cut out and one piece of lead is pasted or cemented at the center of one side of the film packet and the other piece of lead on the other side of the film packet. These two pieces of lead must be superimposed one over the other with the film packet between. Ordinary LePage's or Royal glue may be used to support the lead pieces in place. The film packet, with its lead squares in place, should then be carefully wrapped in a piece of black paper, which should assist in holding the lead squares in place. This packet is to be carried in the pocket of the operator for a period of one week continuously. The film is then developed in clean fresh solutions for the usual time, four to five minutes, and at the usual temperature, 65° to 70° F. If the film develops clear, with no image of the lead squares shown, or with only a faint shadow

of the lead squares, the operator is most probably safe. If the margin of the film outside the lead square area develops out black, the operator should provide more protection for himself. The value of this test depends upon the care and accuracy with which the details are carried out. Also, one single test should not be considered sufficient. The test ought to be made from time to time, especially as the amount of energy used is increased.

The fluoroscopic test requires the use of a fluoroscopic screen, preferably the older hooded box type. This test is best made at night, when the room can be easily darkened and when the eyes of the operator are in the best condition for a test of this kind. With the room dark and the tube delivering the energies used in routine work, the operator may quickly determine any active radiation in his vicinity by means of its action upon the fluoroscopic screen. This test, of course, should be made in the position which he would occupy while making routine exposures. If there is no illumination of the screen, the operator occupies a safe position. A faint illumination of the screen may not be important, but an intense illumination (when the bones of the hand are visible) should receive attention. The fluoroscopic test is the more sensitive of the two and may be made more quickly. If the fluoroscopic method is used, the test should also be made from time to time, especially as the amount of energy used is increased. In the manufacture of Coolidge tubes large quantities of x-ray energy are delivered during the exhausting and testing processes. The workers must be adequately protected and they rely upon the fluoroscopic test mainly. They make frequent fluoroscopic tests from their various stations and even a slight fluorescence receives prompt attention. This is especially necessary in their case, as they are continuously (during working hours) near one or more tubes in operation. The tubes are exhausted and tested within lead-enclosed rooms with heavy lead glass windows through which the performance of the tubes may be watched. The lead used in lining these rooms is about one-eighth inch thick and the lead glass windows about three-fourths inch thick. The average technician (diagnostic) has to protect himself from only a small amount of x-radiation, compared to the amount from which these workers protect themselves.

High Tension.—The high tension current, used to excite the tube, is of equal importance as a dangerous agent. A very severe injury and even sudden death may result from shock received from the high tension circuit.

The overhead should be firmly fixed in position so that it cannot jar loose or fall. No dangling wires from the overhead should be permitted. The tubular overhead is safer than a wire overhead. The cord reels should be in good condition and always wind up the cords out of the way when not in use.

The milliamperemeter scale should be set from high to low or low to high, by means of a cord, as the meter is a part of the high tension circuit. The spark gap terminals or the stabilizer should not be adjusted while the tube is in operation, as both are a part of the high tension circuit. As much of the high tension circuit as possible should be placed out of reach when standing on the floor. There are two rules that every technician should observe religiously and continuously.

First, before closing an x-ray switch, always stop, look, and think. See that everybody present is in the clear, out of the danger zone of all parts of the high tension circuit. Be sure everything is correct, and then proceed. Develop the habit of doing this and your element of danger will be materially reduced. The writer has prevented a number of accidents as a result of this habit, formed during his earlier experiences. Remember that whenever you close an x-ray switch you are, in effect, firing a gun, and frequently a big one. You are responsible for the result and it is up to you to first see what is in front of the gun before you pull the trigger. Also look out for a kick-back to yourself.

Second, never leave the control board with the motor running (even though the x-ray switch is off), especially if any other individual is in sight. Better quickly develop this habit. The writer once left his control board (leaving the motor running) to readjust a patient who had moved from the desired position. Another individual, standing near, unthinkingly closed the x-ray switch. An ambulance was called for but fortunately not needed; it was two weeks, however, before the writer was able to return to his work. During the writing of this paper, the writer received information that a friend and coworker had left his control board (with motor running) to readjust the stabilizer. Some one standing near closed the x-ray switch. He survived the ordeal but will probably lose a part or all of one hand.

When driving a car it is not only necessary to be careful what you do yourself, but it is very essential that you watch the other fellow as well.

Ventilation.—A lack of proper ventilation in the operating room or dark room of an x-ray laboratory will result in a considerable degree of discomfort to the technician, if permitted to continue, and will have a tendency to lower his efficiency as well as to injure his health. Due to the ozone that is liberated in a close room where a high tension current is in operation, the air very soon becomes unfit to breathe. A free circulation of the air in the operating room obviates this danger.

The necessity of excluding all outside light from the dark room somewhat increases the difficulties of proper dark room ventilation. The technician must spend a considerable part of his time in the dark room. A drowsy, sleepy technician is not a safe one and cannot do his best work under such conditions. The dark room is frequently an inside room, but some way can usually be found to provide a free circulation of air, thereby obviating this difficulty.

SECOND, THE PATIENT

X-Ray Exposure.—The danger to the patient while being subjected to x-ray exposure in radiographic work is ordinarily not so great as when an x-ray treatment is given, nevertheless a real danger exists. Occasionally it is desirable to make a number of exposures in succession. Sometimes retakes may be necessary for various reasons. It is essential that the technician keep an accurate account of the total amount of energy delivered to the patient during any one or any series of exposures.

The milliampere-second basis for the measurement of this energy is in common use. The number of milliampere-seconds used is found by multiplying the number of milliamperes by the number of seconds. Example: If 40 milliamperes were used for 5 seconds, 40×5 equals 200 milliampere-seconds. If 100 milliamperes were used for one-tenth second, $100 \times \frac{1}{10}$ equals 10 milliampere-seconds.

The gap or voltage, the distance, and the use or nonuse of a filter are important factors and must also receive consideration.

A general rule which the writer has used for several years and which has proved quite satisfactory follows: Never use to exceed 1,200 milliampere-seconds with a focal skin distance of not less than 15 inches, with a gap ranging from 3 to 9 inches, with an aluminum filter 1 millimeter in thickness. By "focal skin distance" is meant the shortest distance between the focal spot of the tube and that part of the skin of the patient which is nearest to the focal spot. If the aluminum filter is not used, the total of 1,200 should be reduced to 800 milliampere-seconds. The aluminum filter should always be used, as its use interferes very little with the end-result and permits of the use of about 40 per cent more energy than may safely be used without it. The filter is in general use in most up-to-date laboratories.

The above rule may be followed with every region of the body except two, the frontal sinus and mastoid. When a 15-inch distance is used, because of danger of removing the hair, the total number of milliampere-seconds should not exceed 600. When one region of the patient has received the above limit of exposure that region should not be exposed again until after a period of thirty days has elapsed. In no case should the above limits be exceeded unless under direct orders from the radiologist in charge. While the above amount of energy seems to be well within the limit of the danger point, that amount of energy is sufficient for any ordinary routine work unless there is something radically wrong with the technical procedure being used.

There is another rule that should be universally followed: Always ask the patient, before any exposure is made, if he has had any recent exposure, as the answer may prevent the development of an awkward situation. In one laboratory this question was not asked and the owner had to pay the sum of twenty-five hundred dollars to clear up the situation.

High Tension.—Because of the necessity of placing the patient quite near the high tension circuit, this danger must be given careful consideration. If the technician follows the rules given for his own protection, the danger to the patient will be materially lessened. In addition, several other rules should be followed: The patient should be carefully instructed, not in a way to frighten him, but in such a way that he will understand the importance of keeping still and away from the high tension. The greater focal film distances are to be encouraged whenever it may be convenient without a sacrifice in results. The use of the compression band is also to be encouraged whenever convenient, as it not only assists in holding the part still but helps in preventing the patient from coming in contact with the high tension current. The tube at the top of the stand is a good rule for all small children. The tube should be placed crosswise with the patient and never length-

wise. All parts of the high tension circuit should be kept at least twenty inches away from the nearest point of the patient, and a greater distance if at all convenient. All metal parts (table, tubestand, etc.) with which the patient might come in contact during the exposure should be properly grounded in order to avoid any static discharge. While this static discharge is not dangerous within itself, it has a tendency to frighten the patient.

Do not feel that the lower energies are not so dangerous as the higher ones: one patient is known to have died as a result of contact with a circuit of approximately 45 kilovolts peak and 10 milliamperes. Any high tension circuit is dangerous. Even contact with a 110-volt circuit has been known to result in death. The patient is in your charge and you are morally and legally responsible for any accident that may occur, due to your carelessness or ignorance.

THIRD, THE VISITOR

Visitors (aside from assistants) should not be permitted in the operating room during exposure work unless there is a very definite reason for their presence. There is little or no danger of too much exposure to a casual visitor, especially if he is kept at a proper distance.

High Tension.—The visitor must be placed in a safe place and kept there during exposure work. The visitor should never be permitted to assist in holding a patient still except in an emergency. In such emergency, extreme care must be exercised in instructing him and in keeping any part of the high tension as far away from him as possible.

Fluoroscopic Work.—As a rule, all fluoroscopic examinations should be made by the radiologist in charge. It is the usual duty of the technician to prepare the patient. It is also his duty to see that the high tension circuit is at all times kept out of reach of the patient, operator, and any others who may be present. He should look after the general maintenance and operation of the equipment. The writer believes that if the above rules are carefully observed and followed, very few accidents will occur.

This article is not intended to unduly frighten those who work in this field, but, rather, to assist them, by careful, experienced advice, in assuming the responsibilities which they cannot escape. While a technician must assume certain definite responsibilities, the sum total of responsibilities to be assumed is no greater than would be required in many other vocations, for instance, the driving of an automobile. Any vocation which is worth while carries its responsibilities.

In the light of experience, the writer believes that there is no longer any excuse for a serious injury to a patient from x-ray exposures in diagnostic work. If serious injury does occur, it must be due to gross ignorance or carelessness on the part of the operator.

ABSTRACT OF CURRENT LITERATURE

Covering Such Subjects as

ORTHODONTIA — ORAL SURGERY — SURGICAL ORTHODONTIA — DENTAL RADIOGRAPHY

It is the purpose of this JOURNAL to review so far as possible the most important literature as it appears in English and Foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Compression Paradentosis. Loos (Frankfurt a M). Deutche zahnaerztliche Wochenschrift, August 2, 1925, xxviii, 15.

The author states that over 300 names have been given to alveolar pyorrhea but this does not deter him from adding another which seems to have been adopted officially by some of the German dental societies and dental journals. This means of course that the disease is not really alveolar but is seated in the paradentium. The termination "osis" as distinct from "itis" indicates that the disease is not a simple infection but, in this case at least, a combination of an inflammatory with an atrophic process. The term paradentosis, however, is admittedly defective when the condition is compared with others of the "oses" (thus a nephrosis is a kidney lesion due to toxins, the name being given to distinguish from nephritis, a bacterial infection). The adjective "marginal" prefixed to paradentosis aids in localizing the process. With this conception of the disease the condition "alveolar pyorrhea" in the narrower sense becomes a clinical form or stage of the process. The author prefers "purulent paradentosis" to alveolar pyorrhea. This form further indicates that the infectious or inflammatory element is emphasized in this clinical form of the basic disease. In contradistinction to this form we have the atrophic expression of the disease and since this is due to mechanical causes the author would give it the full name of "pressure (or compression) paradentosis," or "atrophic paradentosis," or "traumatic paradentosis." The author gives numerous cases which serve to illustrate that the latter form may occur in the pure phase (isolated pressure paradentosis). In these cases there is not the slightest evidence of gingivitis or retraction of the gum. In one patient the condition could be readily connected with abnormal pressure due to certain anomalies of occlusion.

Etiology of Dental Caries. J. A. Marshall (San Francisco). The Pacific Dental Gazette, August, 1925, xxxiii, 8.

This is one of the most elaborate papers on the subject of caries, if we may judge from the number of references appended, which exceeds 250. The author reaches no general conclusions so that we must assume that the etiology is still obscure. He isolates five possible causal elements: anatomic, bacterial, endocrinic, salivary and dietetic. Under anatomic are reckoned developmental de-

fects not due to other causes, primary anomalies of development. These are difficult to distinguish from secondary developmental defects, due to diet, endocrine influence, infection in early life, etc. In fact there may be no such a casual element possible unless we except hereditary and familial influence and this must be very slight. The subject of the bacterial causation shades into the salivary factor to some extent and also into the food factor. Thus the acidity of the saliva might be primary or due to the action of certain bacteria or to the fermentation of certain food articles. Acidophile organisms may act on certain carbohydrates of the diet and produce a high degree of acid mouth but some teeth remain immune to such influence and we cannot learn the secrets of the immunity and susceptibility to caries from study of bacteria or of acid mouth. The endocrine factor is no less obscure and it has been suggested that there is a special dental hormone but no evidence has thus far been submitted. In a consideration of the saliva as a possible influence the author again takes up the subject of acid mouth and discusses the possibility that the enzymes may have a hostile action on the teeth and that in general a certain state of the saliva is favorable to acid fermentation. The subject of diet comprises drinking water, diets, defective in mineral matter and protein, and especially possible vitamin deficiency, this subject promising more than any other for future advances.

Remarks on the Conception of Paradentosis. F. Adler (Berlin). Zahnaerztliche Rundschau, July 5, 1925, xxxiv, 27.

The isolation of the "paradentium" means much more than mere theorizing, for among other advantages it enables us to visualize pyorrhea alveolaris as a disease entity and also the possibility of a successful treatment. Through the labors of German investigators this concept is firmly entrenched today. The unsatisfactory teaching for decades concerning alveolar pyorrhea has now given place to a new doctrine which harmonizes with the general advance in pathology and management of disease. The term "alveolar pyorrhea" so long in vogue must now be supplanted by a more general expression—"paradentosis." Suppuration at the margin of the alveolus is only an episode of a certain malady and by no means the disease itself. The situation is not without precedent for the word "gonorrhea," meaning discharge of semen illustrates the conflict between usage and reason. In 1746 Fauchard mentions the affection as a special new type of scurvy while the term "alveolar pyorrhea" originated with Toirac in 1839. The author does not trace the history beyond this point and does not even mention Riggs. In recent times Lang first called the condition "paradentitis" but objections were at once filed and Kantorowicz and Weski especially advocated the substitution of "paradentosis" both from the nature of the disease process and because there is a marked endogenous or intrinsic causal element of the disease. Analogies have recently been pointed out between pyorrhea and the metallic poisonings (lead, mercury, bismuth) which shows selective action on the gums. To sum up the entire situation briefly bacteria do play a rôle in this affection but not until the tissues have first been damaged by internal causes which seem able to involve both soft parts and bone in the predisposition.

Facial Hemiatrophy from Abscessed Molar Tooth. J. M. H. Macleod. The Dental Surgeon, Aug. 29, 1925, xxii, Whole Number 1027.

Atrophy of one-half of the face is at best a very rare and obscure affection. The author reported a case of it before the Royal Society of Medicine which should be of interest to the dental profession because it originated apparently from an abscessed upper molar tooth. The patient was at the time thirty years of age. The abscess occurred at the age of nine years, about the right upper, first permanent molar. The offending tooth was extracted at the time and there remained a scar on the skin, the origin of which is not explained. It is stated that eight years later the "mucous membrane was incised to prevent adhesion between the skin and bone." At any rate this little operation was promptly followed by an atrophy "which gradually spread until it involved the right side of the face from the lower border of the inferior maxillary bone as far up as the malar bone." The texture of the skin was unaltered and there was no abnormality of sensation. The atrophy involved first of all the subcutaneous tissue and the fat and in a lesser degree the musculature and the bone. This atrophy has resulted in the hollowing of the cheek of the offending side. The right side of the palate is set down as flattened. While the entire morbid process is extremely obscure it is evident that in cases like the above a suit for damages might be instituted against the dentist who attended to the abscessed tooth, on the principle of sequence. There would be little chance of winning such a case, but litigation under the circumstances would not be agreeable.

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EDITORIALS

Caution in Using Compressed Gas Cylinders

The Interstate Commerce Commission has prescribed certain regulations pertaining to the shipment of dangerous articles by rail. These regulations include specifications for the manufacture and testing of cylinders used in transporting gases compressed to pressures over 25 pounds per square inch. The Regulations prescribe certain cylinder test requirements which must be complied with before the cylinders are acceptable in interstate or intrastate commerce by freight or express. Tests are considered necessary in order to reduce to a minimum the hazard of having in circulation cylinders which are not in proper condition to withstand the service for which they are intended.

The gases which are commonly shipped in these cylinders, and the intervals at which the cylinders must be tested, are as follows:

NAME OF GAS	INTERVALS AT WHICH CYLINDERS SHOULD BE TESTED
Acetylene	Once—before putting in service.
Anhydrous Ammonia	Every 10 years.
Carbonic Gas	" 5 "
Chlorine	" 5 "
Ethylene	" 5 "
Helium	" 5 "
Hydrogen	" 5 "
Hydrocarbon gases (other than Acetylene)	" 5 "
Methyl Chloride	" 5 "
Nitrous Oxide	" 5 "
Oxygen	" 5 "
Sulphur Dioxide	" 5 "
Non-liquefied gases with pressures not over 300 pounds	Once.

When cylinders have been tested the date, that is, the month and year in which the test was made, must be stamped into the metal of the cylinder near the top, i.e., a cylinder tested in March, 1925, would bear the markings "3-25."

In order to safeguard the interests of all concerned with cylinders charged with compressed gases, those who use the cylinders should observe the markings showing the dates on which the containers were tested. If at any time cylinders are found which are overdue for test the owner of those cylinders should be promptly notified that the containers are not tested and marked in compliance with the regulations prescribed by the Interstate Commerce Commission.

In order to insure the greatest safety cylinders charged with compressed gases should at all times be containers which have been tested in compliance with prescribed regulations. The use of cylinders which have not been so tested, whether in transportation or in service, is unwarranted, and all those dealing with compressed gases should be actively interested in preventing the use of gas cylinders which are not tested as prescribed by the Interstate Commerce Commission.

Die Frakturen der Kiefer.—Carl Herber*

The author in a scientific way takes up the fundamentals relating to fractures of the jaws. He emphasizes how the surgeon is handicapped in the treatment of these special cases and how the dentist comes to his assistance so as to bring about the desired results. Fractures in general is the subject first discussed; this is followed with points of interest regarding the anatomy of the mandible; then the symptoms of fractures of the lower jaw; the prognosis; therapeutics; fixation of its parts; use of extraoral appliances, intraoral appliances, and their combinations. The author then enters into a

*Published by Berlinische Verlagsanstalt.

similar discussion regarding the upper jaw, and ends up with a brief review on surgery for dentists during war times, and the technic necessary for properly performing his duties.

This whole subject matter has been fairly well presented as far as it has been taken up, but from the point of view of modern oral and plastic surgery a great deal would have to be discarded and replaced in order that we may carry out an efficient and successful course of treatment.

—F. N.

ORTHODONTIC NEWS AND NOTES

A Three-Day Postgraduate School to Be Conducted by the Dental Society of the State of New York

The Fifty-Eighth Annual Meeting of the Dental Society of the State of New York will be held at the Hotel Astor, in the City of New York, May 19, 20, 21, and 22, at which important papers will be presented by prominent essayists, together with a specially prepared program of Clinics, selected because of their educational value, and in order that the subjects taught in the Educational Courses may be further elucidated by demonstrations from different men.

EDUCATIONAL COURSES

Prior to the regular meeting an Intensive Three-Day Postgraduate School will be conducted under the name of "Educational Courses," Monday, Tuesday and Wednesday, May 17, 18 and 19, 1926, day and night sessions. These courses have been selected to meet a demand indicated by a ballot among over 3,000 members of the Society. The following courses have been projected: 1. Full Denture Technic. 2. Partial Denture Technic. 3. Root Canal Technic, including Radiography. 4. Extraction, with special reference to difficult cases, imbedded roots, etc. 5. Anesthesia, local and by inhalation. 6. Removable Bridge-Work, various types. 7. Bridge-Work, fixed and partially fixed. 8. Cast Gold Inlays, direct and indirect technic. 9. Orthodontia, for the general practitioner. 10. Periodontia, for the general practitioner. 11. Porcelain Jacket Crown Construction. 12. Physical Diagnosis. 13. Office management.

Each course will have at least three teachers, and candidates may enroll for one or for all three teachers, thus rendering it possible for men to make their studies purely elective.

All members of the American Dental Association will be eligible to take these Educational Courses. A booklet, fully outlining the details of the various courses of study, with the names of the teachers and the special parts of the subjects that each will teach, will be ready for distribution early in January. All who are interested, and who wish to receive this booklet will please send their names and addresses to Dr. Edward Kennedy, 347 Fifth Avenue, New York City, Chairman Committee on Educational Courses.

Chicago Dental Society's Annual Meeting and Clinic, January 27, 28 and 29, 1926. Drake Hotel

The sixty-second annual meeting and clinic of the Chicago Dental Society will be held at the Drake Hotel, Chicago, January 27, 28 and 29, 1926, Wednesday, Thursday and Friday. The plans for this meeting have been perfected

and contemplate the establishment of a new mark in program building. That the 1926 meeting will excel all previous records of this society is witnessed by the following facts:

1. There will appear on the literary program 256 men to present papers, addresses and discussions in the ten different sections, and at two noon day luncheons and the two big general session meetings.

2. Two one-half days will be devoted to clinics—Thursday afternoon and Friday morning. This clinic program will consist of seven types, as follows:

(a) Progressive clinics.
(b) Lecture clinics.
(c) Section clinics.
(d) Junior clinics.
(e) Table and chair clinics.
(f) Study Club clinics.
(g) Senior student clinics.

There will be a total of 200 clinics, 100 to be given each half day

3. The president of the American Dental Association, Dr. Sheppart W. Foster, and Mrs. Foster, will be the guests of honor at a banquet which will be followed by a program of dancing and entertainment.

4. The number of commercial exhibits will excel all previous records, for more space has already been sold (October 10) than at any previous meeting of this society.

Railroad rates have been secured for this annual meeting.

A special invitation is extended to all members of the American Dental Association and to dentists living in foreign countries who are members in good standing of their national societies.

Hotel reservations should be made immediately, direct with the hotels.

We are gratified to announce to the profession that Dr. Otto U. King, General Secretary of the American Dental Association, is chairman of the Program Committee.—M. M. Printz, President; Hugo G. Fisher, Secretary.